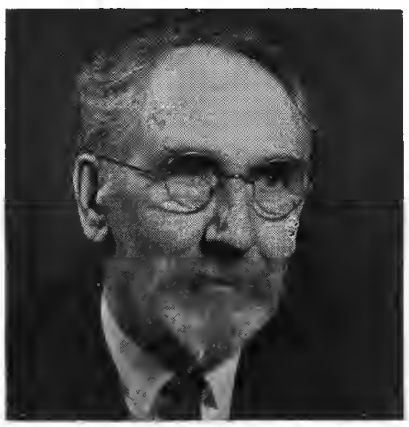
Briefing for October

By all odds one of the most serious war problems of the day is manpower. Stated simply, successful solution to the problem is found only when there is provision of enough armament to win. We all know by now that not enough airplanes is not enough armament to win. Associate Editor Foster takes a very critical look at the West Coast War Manpower Program and finds it only a stopgap. In his report on page 110 he warns of a relapse into the "too little, too late" policy which we were supposed to have abandoned in assuming the offensive against our enemies.

A witch hunt for "war profiteers" is on in full swing and has yet to reach its peak. The aviation industry is the No. 1 candidate merely by virtue of its being one of the biggest and certainly the most spectacular war producer. But this is about all the ammunition the



Sonford A. Moss is best known as the "father of airplane superchargers." Further, he has long been interested in the integral power plant idea, and a series concerning his proposals, together with synopses of expert opinions, began in September AVIATION. Dr. Moss' concluding installment appears this month on page 148.

hunters have—because the industry certainly hasn't and won't have much to show by way of excessive profits. Just how lean a profiteering case aviation presents is demonstrated by Financial Editor Hoadley on page 114.

Gen. Chennault proved that the relative superiority of one airplane over another was almost an academic question compared to the relative merits of fighting tactics. Much of the success of the historic defense of Malta by the RAF was due to fighter tactics, basis of which was the line-abreast formation. J. L. Lowrey participated in the Malta battles as an RAF fighter pilot and is now a test pilot with Republic Aviation Corp. On page 192 he describes the fighter fundamentals in detail.



Reagan Stunkle, general service manager for Lockheed and Vega, has recently returned from the battle fronts where he made a thorough inspection of the procedures involved in insuring satisfactory delivery and maintenance of his companies' products which have been doing such a spectacular job of bammering the Nazis. His description of how they "keep 'em flying" over there is on page 112.

Another of AVIATION'S important "Design Analyses" appears on page 119, with the Fleetwings BT-12 basic trainer the object of a complete part-by-part breakdown. Crammed with fundamental design information, weights, measurements, and structural details, the article is rounded out as an invaluable reference work by numerous perspective sketches and photos of the important components.

While headline hunters reaped their harvests with vague promises of numerous planes they would build sometime, Douglas has been quietly producing unbelievable quantities of the "old workhorse" everyone knew could do the job. Its system for building C-47's (military DC-3's) in quantities once thought impossible is described on page 135 by Jock Simpson.

With air speeds around 500 mph. utilized in modern wind tunnels, the factor of control is of considerable importance. A detailed description of the apparatus involved will be found on page 162.

Modification is not a wartime phenomenon. Airline engineers have been modifying standard equipment for many years in order to adapt it to local operating conditions. This is done through maintenance facilities, and a description of what TCA engineers have accomplished begins on page 213.

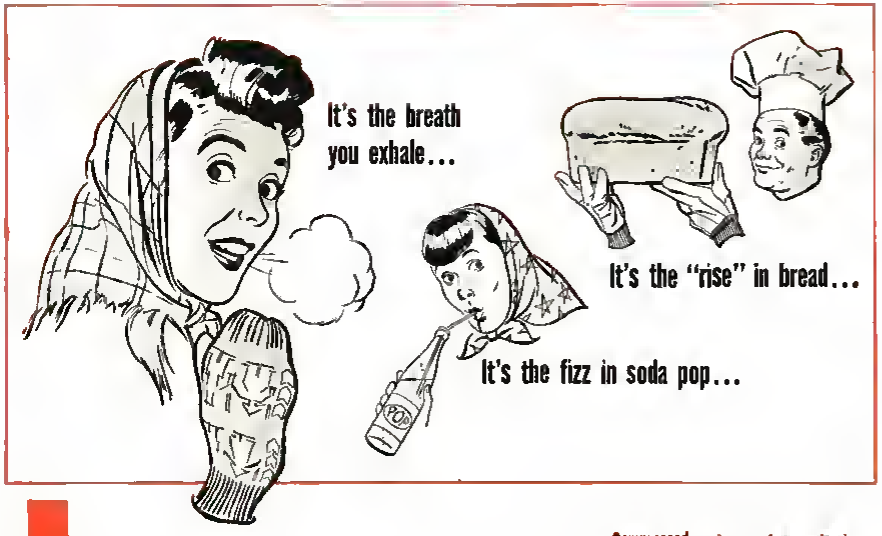
From refrigerators to wings for mighty P-47 *Thunderbolts* is a big jump, but when the need arose, Servel made it—and in a hurry. First word on how this conversion was made is on page 142.

Down the Years in AVIATION'S Log

25 Years Ago (1918)—Drawings of giant Zeppelin four-engine bomber reveal it to have a 161-ft. span. . . . Post Office lists airmail expenses for the month, including fuel, as $968.80. And total cost for the same period, including $173.02 for office force, was $10,001.49. Meanwhile, Post Office denies published story that Washington-New York-Boston airmail service was about to be operated. . . . More than 500 employees of the Wright-Martin Aircraft Corp. celebrate opening of huge new building "capable of housing 1,000 men at work". . . . Sen. New (Ind.) introduces bill to create Department of Aeronautics, with chief to be appointed by President.

15 Years Ago (1928)—At National Air Races (Los Angeles) *Wasp*-powered Boeing fighter wins free-for-all by climbing to 10,000 ft. and return in 5 min. 26 sec., also winning first place in level flight with speed of 171.8 mph. . . . Aero Chamber appoints commission, under chairmanship of Casey Jones, to inquire into flying school standards. . . . J. C. Penney, Jr., chain store magnate, brings three leading German glider experts to this country to inaugurate glider schools, first to be at Corn Hill near Provincetown, Mass. . . . Capt. T. Komanura, Imperial Japanese Army, enters MIT to do special work in airplane design and aerodynamics. . . . Lieut. James Doolittle is ordered to Mitchel Field to study fog problems.

10 Years Ago (1933)—New York *Times* comments editorially on innovation of berths in overnight planes to West Coast. Writer thinks that sleep might be hard to obtain because of "air pockets" and he winds up with comforting suggestion that prospective traveler get life insurance "for the family". . . . Congress appropriates $3,300,000,000 for PWA airport projects. . . . Adm. Byrd sails for Antarctic with a Curtiss *Condor* and an autogyro on board.



It's carbon dioxide . . . it's now a new industry!

Compressed and stored in cylinders, carbon dioxide is being put to work by Kidde in many fields. It's one of the fastest fire fighters known. It's a powerhouse of energy quickly available in emergencies. The harnessing of carbon dioxide and other compressed gases forms a new industry, full of promise for the future.



Walter Kidde & Company has devoted itself to the science of harnessing gases under pressure. War has greatly advanced the scope of this work. New uses are constantly being discovered, which will promote the comfort and safety of the postwar world.

Kidde

WALTER KIDDE & COMPANY, INC., 1016 MAIN STREET, BELLEVILLE, N. J.



MEDICAL MISSION!

An urgent request for medical supplies is received from an isolated outpost. Dressings, drugs, plasma . . . all needed in a hurry. Terrain too tough for land vehicles.

But, the vital, life-giving supplies go through to their destination quickly and surely in the Piper L-4 "Grasshopper" Parachutes carry the precious cargo to our hard-fighting boys. Wounds are healed, lives are saved . . . thanks to this wartime version of the famous Piper Cub.

It also directs artillery fire and troop movements, acts as a scout, transports officer personnel and delivers messages. The Piper L-4 is ideal for these duties because of its remarkable maneuverability and because it can land quickly almost anywhere and be hidden easily. These wartime uses and developments in design promise you a finer, safer, more economical peacetime Piper Cub.



FREE BOOKLET ON HOW TO FLY. Send today for your copy of "You, Too, Can Fly!" If you also want the full-color Piper catalog, enclose 10¢ in stamps or coin for postage-handling. Piper Aircraft Corporation, Dept. A103, Lock Haven, Penna.

16mm. SOUND FILM—"The Construction of a Light Airplane." For distribution points write Supervisor, Audio-Visual Aids, Extension Services, Penna. State College, State College, Penna.

PIPER *Cub*

Points the Way to Wings for All Americans

Trail Blazing in the Skies

1917-1918



"SO FAR AS CAN BE LEARNED, NO STEAMER WAS EVER MOLESTED BY SUBMARINE (DURING WORLD WAR I) WHEN ESCORTED BY A NON-RIGID AIRSHIP."

—from report of the late Rear Admiral W M Moffett, U S N, to the House Naval Affairs Committee

In the first battle of the Atlantic, Goodyear was America's principal producer of lighter-than-air ships, building upwards of 100, most of which saw active service along the sea frontier

1942-1943



"NOT ONE OF THE THOUSANDS OF TRANSPORTS AND SUPPLY VESSELS THAT HAVE BEEN ESCORTED BY THE NAVY'S NEW NON-RIGID AIRSHIPS HAS BEEN LOST TO SUBMARINE ATTACK."

—from official U S Navy report, July, 1943

History repeats itself in more ways than one Today Goodyear is again the nation's major designer and builder of airships, now equipped to mass-produce the world's largest non-rigid ships as a result of more than 30 years' continuous experience in lighter-than-air development.

Back the attack with WAR BONDS

HOW GOODYEAR AIRCRAFT CORPORATION SERVES THE AIRCRAFT INDUSTRY

1. *By constructing subassemblies to manufacturers specifications*
2. *By designing parts for all types of airplanes*
3. *By re-engineering parts for mass production*
4. *By extending our research facilities to aid the solution of any design or engineering problem*
5. *By building complete airplanes and airships*



GOODYEAR

GOODYEAR AIRCRAFT

WHAT'S NEW IN RUBBER FOR AMERICAN AIRCRAFT



SAFETY INSURANCE FOR "TRICYCLES"

The possibility of accidents resulting from the puncture or blowout of nose-wheel tires on tricycle-gear airplanes is now greatly reduced by use of the Dual-Seal inner tube, developed by Goodyear. This amazing tube is an adaptation of the famous LifeGuard made by Goodyear for passenger car tires As the illustration above shows, it is a 2-ply tire within a tube If the outer compartment (A) is punctured or blows out during the take-off, the inner compartment (B) *expands*, filling out the tire to normal size This inner compartment holds enough air pressure to keep the tire firmly seated on the rim for the duration of the flight, and provides sufficient rolling radius for a safe, three-point landing Because there is great need for this nosewheel tire protection on advanced desert and jungle operating fields, Goodyear Dual-Seal tubes are being widely used today on all types of tricycle planes.

LifeGuard—T M The Goodyear Tire & Rubber Company



A BETTER "MAE WEST"

The present type of self inflating life vest built of rubberized fabric, in place of former all-rubber, air cell construction, is a Goodyear development. This new type is faster to build, requires less critical rubber and is 100% efficient, as its great war record proves.



WHEEL HEADQUARTERS

Goodyear is today one of the world's largest manufacturers of magnesium alloy airplane wheels and brakes Our fine metallurgical laboratory and long experience in wheel and brake design and construction insure rolling gear of the highest quality, perfectly balanced and free from metallic faults. All sizes available



PRODUCTS FLIGHT-TESTED

Goodyear maintains its own laboratories and airplanes where new aeronautical developments are thoroughly tested and proved before being offered to the industry You can depend on all Goodyear products — because they have been proved in the air!

OUR ENGINEERS ARE AT YOUR SERVICE



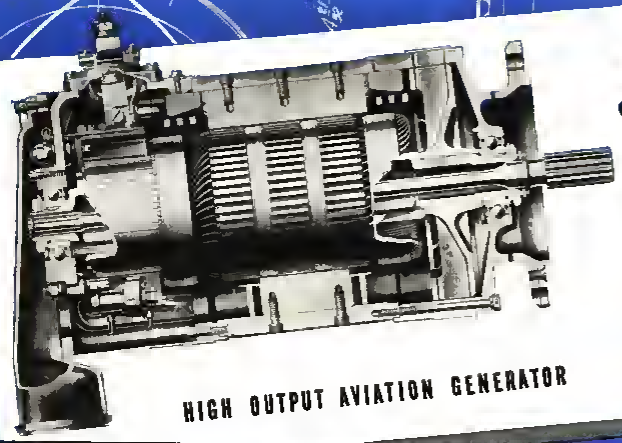
With a background of more than 30 years experience in developing tires, tubes, wheels, brakes and other aircraft accessories, Goodyear engineers are ready to help you work out any problem involving such products, particularly those made of rubber — either natural or synthetic Address Goodyear Aeronautics Dept., Akron 16, Ohio or Los Angeles 54, California.

Back the attack with WAR BONDS

GOODYEAR

THE GREATEST NAME IN RUBBER

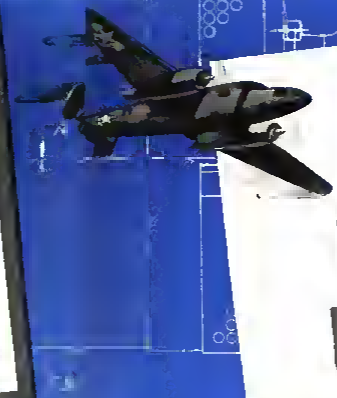
AERONAUTICAL RUBBER GOODS • TIRES • TUBES • WHEELS • BRAKES



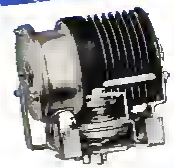
HIGH OUTPUT AVIATION GENERATOR



Eclipse* Type 914 Aviation Generator. Designed to convert high speed mechanical energy into electrical power for battery charging and other requirements. Integral fan and blast cooled, interpole and compensating coils, and pencil type drive shaft assure dependable performance at rated speeds.



CARBON PILE VOLTAGE REGULATOR



Eclipse Type 1042 Carbon Pile Voltage Regulator provides a compact, light-weight voltage control for either single or parallel generating systems. Mountable in any position, these precision built units assure precision control of aircraft power supply systems.

DEPENDABLE POWER... PRECISION CONTROLLED

DESIGN CHECK CHART, ECLIPSE TYPE P-2 GENERATOR

Application

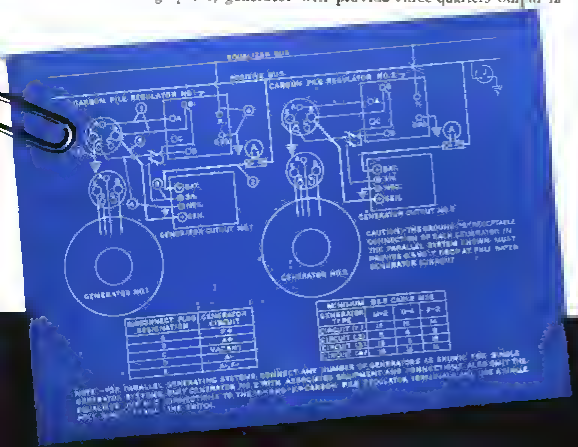
- For application as an electrical power supply source to aviation engines incorporating a 3 to 1 generator drive ratio and with provisions for air blast cooling.
- For application as an electrical power supply source to auxiliary engines incorporating a 6,000 RPM generator drive speed. No provisions for air blast cooling necessary.

Performance

- For main engine applications with provisions for blast cooling, continuous full load rating 200 amperes, 28.5 volts, at 5,000 to 10,000 RPM. Permissible intermittent overload 300 amperes, 28.5 volts.
- For main engine applications wherein aircraft is operating at low cruising speeds, generator will provide three quarters output or 150 amperes, 28.5 volts at 4,400 RPM.
- For auxiliary engine application without provisions for blast cooling, continuous full load rating 200 amperes, 28.5 volts at 6,000 RPM.

Design

- Designed for increased strength, generator incorporates a steel mounting head and a floating type flexible torque drive shaft which absorbs engine torsional vibration and compensates for any slight possible drive misalignment.
- On main engine applications air blast cooling internal cooling fan and hollow armature shaft assure full load at minimum temperatures. For auxiliary engine application, internal fan provides adequate cooling.
- Improved generator terminal design, with brush rigging freely accessible for brush replacement and adjustment of spring tension, plus improved brush material for high altitude operation, assure dependable operation and long service life.
- Fixed brush positions requiring no adjustment plus inclusion of interpoles and compensating windings permit improved commutation and increased overall generator efficiency.
- Compactly designed, weight only 36.6 lbs., overall dimensions are 12⅝" long by 6" in diameter.



DESIGN CHECK CHART, ECLIPSE TYPE 1042 CARBON PILE VOLTAGE REGULATOR

Application

- For application to 24-volt aircraft electrical systems to regulate the voltage of single or parallel operated engine driven D.C. generators to a constant and predetermined value at varying speeds and load requirements.

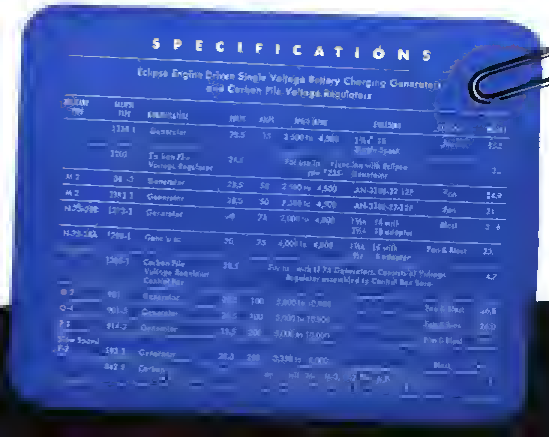
Performance

- Regulates voltage of generators in 24-volt systems within plus or minus 2% of setting, where maximum power dissipation does not exceed 100 watts under blast cooling operation, or 75 watts without blast cooling.
- Adjustable to maintain between 26 to 30 volts over a resistance range of 7 to 55 ohms. In parallel systems regulator will divide full load current within plus or minus 5%.

Design

- Automatically controls generator field current by continuously varying resistance of field.
- Pressure, controlled by a solenoid coil connected across output, is exerted on a stack of carbon discs, thereby varying carbon pile resistance, and providing even, continuous regulation without lag or fluctuation.
- Produces a minimum of radio interference due to absence of regulator contacts of the vibrating type.
- Designed for plug-in connection to standard base, facilitating installation and removal. To compensate for voltage line drop and facilitate paralleling generators, a rheostat is provided for adjustment purposes.
- Compensating windings insure equal division of load to each generator in parallel operated systems. Finned regulator housing provides for rapid heat dissipation.
- Compact and weighing only two point six (2.6) pounds, the overall dimensions are 4⁹/₁₆" long, 4¹/₁₆" wide and 3⅞" high.

THE INVISIBLE CREW — Bendix — AVIATION CORPORATION



SPECIFICATIONS

Eclipse Engine Driven Single Voltage Battery Charging Generators and Carbon Pile Voltage Regulators

MILITARY TYPE	ECLIPSE TYPE	NOMENCLATURE	VOLTS	AMPS	SPEED RANGE	FINISH	APPROX. WEIGHT
	1238-1	Generator	28.5	50	2,500 to 4,500	2¾" SR Straight Spline	3.2
	1260	Ex Line 28-Volt Voltage Regulator	24.0		For use in Parallel Systems with Eclipse 1238-1 Generators		3.2
AN 2	38-3	Generator	28.5	50	2,500 to 4,500	AN-3286-32 Type	3.2
AN 2	1238-1	Generator	28.5	50	2,500 to 4,500	AN-3286-32 Type	24.0
AN-3286-32B	1238-1	Generator	28.5	50	2,500 to 4,500	AN-3286-32A Type	24.0
	1238-1	Generator	28	75	2,000 to 4,000	1¾6 16 with 19 splines	24.0
N-28-28A	1238-1	Generator	28	75	4,000 to 6,000	1¾6 16 with 19 splines	Blast 3.6
	1260-1	Carbon Pile Voltage Regulator Control Box	28.5		For use with 1238 Generators. Consists of Voltage Regulator assembled to Control Box Base	Pins & Base	23.
AN 2	901	Generator	28.5	100	2,000 to 4,000		4.7
AN-4	901-1	Generator	28.5	100	2,000 to 10,000	Spline Shaft	4.8
P-2	914-2	Generator	28.5	200	4,000 to 10,000	Spline Shaft	36.0
Blow Sound						Pins & Base	
P-2	1283-1	Generator	28.0	200	3,300 to 6,000		
	1042	Carbon Pile Voltage Regulator				Pins & Base	

Eclipse

ECLIPSE-PIONEER DIVISION

Aviation Accessories

Teterboro, New Jersey

THE BG SPARK PLUG TEST SET



Tests The Electrical Security of Spark Plugs.
Uses High Voltage Bridge Circuit.
Operates from a 110 Volt, 60 Cycle AC Source.
Also Furnished for Operation on Other AC Voltages.
Requires Only a Supply of Dry Gas.
(Carbon Dioxide or Nitrogen)
Set Includes Pressure Regulator.

ARMY E NAVY

Model M-591 AC 110V-60 Cycle Model M-600 AC 220V-60 Cycle
Model M-601 AC 110V-25 Cycle

BG

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Contractors to the United States Army, Navy and Coast Guard and Aircraft Engine Builders

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Custom built for your special work in any grain, grade or size, to meet today's exacting, get-the-job-done demands

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● Some users may still be skeptical, but we assure you again that we make quick shipments. You see, with WPB approval, we now specialize* on Grinding Wheels and Mounted Wheels and Points up to 3" in diameter only. All larger sizes are out for the duration. Then too, our central location brings most customers within one day's shipping distance.

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FREE TEST WHEEL—To get acquainted with these fine wheels and our fast service, we'll send one postpaid. Tell us size wheel and material you'd like to try it on.

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SAVING HORSEPOWER to SAVE FREEDOM!

BOILED right down to basic facts, it's horsepower of a hundred kinds that's deciding this war...horsepower giving mobility and meaning to the firepower in the hands of the American fighting man, who grew up with his foot on a throttle.

An unconquerable combination—American men and motors! It's an honor and an inspiration to every Sealed Power man and woman to serve every branch of our armed forces with the products that have won the trust of peacetime America.

Sealed Power Aircraft Piston Rings, through sound basic design, carefully controlled materials and rigidly maintained precision standards, offer important advantages in safeguarding power and saving precious fuel.

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BUY AT LEAST ONE EXTRA $100 WAR BOND THIS MONTH

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SCRAP METAL IS NEEDED FOR EVERY GUN, TANK AND SHIP. SEND YOUR SCRAP TO WAR.

PISTON RINGS—PISTONS—CYLINDER SLEEVES





HOW PAN-AMERICAN PROTECTS HYDRAULIC LINES DURING OVERHAUL

Adherence to a rigid policy of *perfection with speed* in overhaul is one of the vital contributing factors to Pan American World Airways remarkable performance record. Hydraulic systems on these giant ships of the airways are *positively sealed* with metal Tubing Seal Caps and Seal-Plugs during overhaul. No risk is taken that would allow one speck of dirt or dust, one minute drop of moisture, to enter. Pan American's experience proves that metal Tubing Seal Caps and Seal Plugs are *essential in overhaul* to SEAL OUT all foreign matter and to SEAL IN all fluids that need not be drained during overhaul. For *maintenance* as well as *manufacture*, use these perfected guardians of vital hydraulic lines and fittings. Write for 32 page instruction manual on tubing fabrication and maintenance.

"Tools are weapons—treat 'em right"





Ask for data on Liverman Torq-Stop Wrench, too

TUBING SEAL-CAP, INC.

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Nightwatchman on Duty

American boys are sleeping down there on that tiny dot of land set in the endless nothingness of the Pacific.

They can sleep because they've got a nightwatchman on duty up here patrolling the skies. A fighter pilot of the Army Air Forces flying an Army Bell Airacobra, he's an alert, a deadly efficient nightwatchman.

His plane gives him visibility unsurpassed by any single engine fighter in the world. His plane has blinding speed, modern instruments for night flying and a two-way radio. At his fingertips are controls for a cannon and a battery of machine guns.

He can find the enemy, sound an alarm—then deal smashing blows.

Rest easy, down there below...the nightwatchman is on duty.

WHEN it's over over there Amerikan aircraft will have new duties in peaceful travel and commerce. In designing and building the first Airacobra, in constantly improving it, we've learned plenty about making planes simpler, safer, more foul proof and trouble free. You'll see what we mean. © Bell Aircraft Corporation, Buffalo and Niagara Falls, New York.

BELL Aircraft

AIRACOBRAS for victory—future planes for peace

BUY WAR BONDS AND SPEED VICTORY

CURTISS-WRIGHT



SUPREMACY
in the Stratosphere

Aviation's sights today are trained on the stratosphere, the key to military and world trade supremacy.

But before science can conquer the rarefied, sub-zero heights of the earth's ocean of air, answers must be found to a multitude of problems, for planes and men will be entering a sphere considerably beyond today's limits of flight.

To speed this epic exploration, Curtiss-Wright has completed the world's largest altitude chamber—where, without leaving the ground, airplane cabins and fuselages with all their complex equipment can be tested exhaustively under stratospheric conditions.

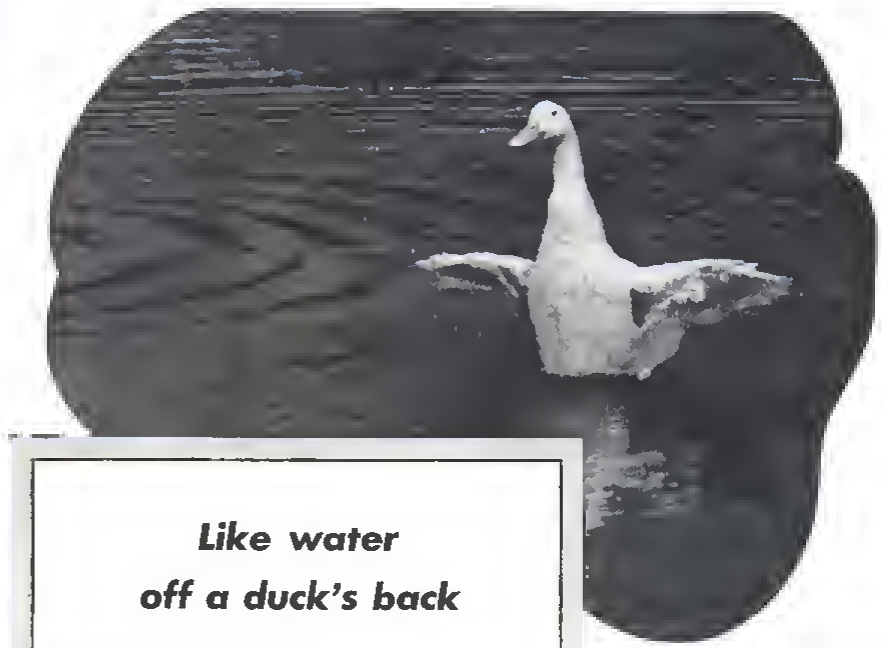
It is, we believe, a contribution of far-reaching importance to America's leadership in aviation



CURTISS-WRIGHT
Corporation
AIRPLANE DIVISION
BUFFALO • COLUMBUS • ST. LOUIS • LOUISVILLE

Member Aircraft War Production Council, East Coast Inc

Nine minutes after this scientist steps into the Curtiss altitude chamber he can reach flying conditions equivalent to those found nearly eight miles above the earth's surface in rarefied air 70 degrees F. below zero.



Like water off a duck's back

A DUCK is just naturally waterproof. He's built that way. Being waterproof is his specialty. It enables him to do a lot of things that a chicken, for example, can't do.

Just as a duck sheds water, Hycar synthetic rubber sheds oil. For Hycar's specialty is oil-resistance. Particularly oil-resistance in the presence of heat, abrasion, pressure, or aromatic hydrocarbons. The oil-resistant types of Hycar are built that way. But the *degree* of oil-resistance is closely controlled, tailored to the job. Oil-swell can be held to ±1%, or even to zero. In addition, Hycar can withstand temperatures of 250°, abrasion resistance is 50% in excess of natural rubber, and compression-set characteristics are excellent.

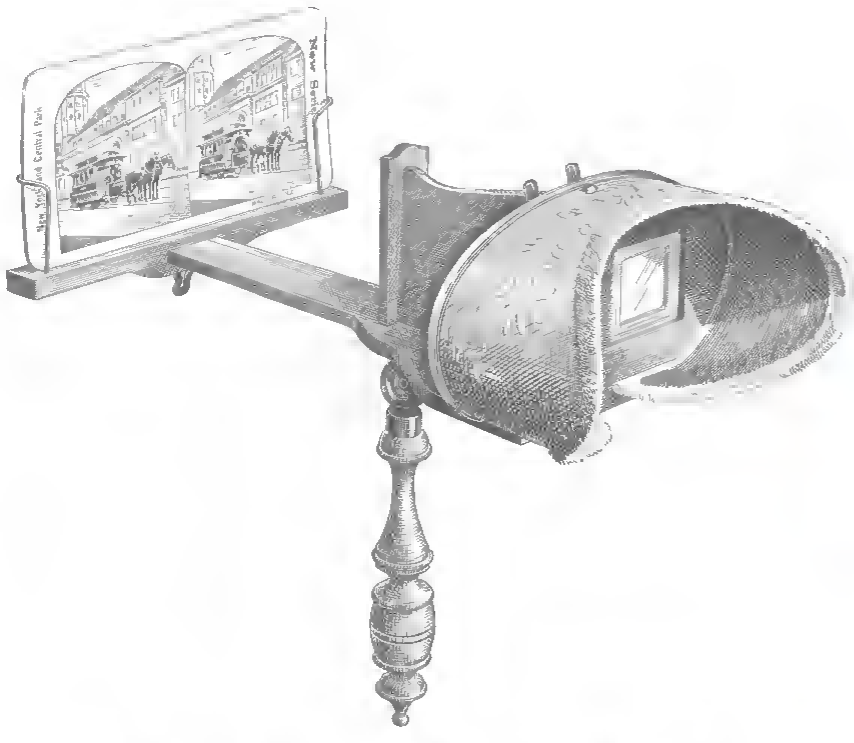
Hycar is light—20% to 25% lighter than many other synthetics. And its resistance to oil absorption keeps it light

Aren't these the qualities you have wanted in oil and fuel hose, hydraulic lines, seals, gaskets, grommets, diaphragms and other resilient products you use? *Hycar Chemical Company, Akron, Ohio.*

Hycar is supplied in crude form to rubber fabricators. Because of its outstanding performance in war uses the demand far exceeds the supply. But now is the time to work out with your supplier of rubber products ways of obtaining Hycar for actual test in your own applications, both present and future. It's to your advantage to gain experience now against the day you will need new and even better rubber products. Our technical staff and laboratory are ready to help.

Hycar

LARGEST INDEPENDENT PRODUCER OF BUTADIENE *Synthetic Rubber* IN AMERICA



THIS? A WAR WEAPON?

Remember the old-fashioned stereoscope — grandfather's substitute for the movies? Remember how it made pictures stand out in three-dimensional relief?

Well, the same idea is being used in stereoscopic airplane cameras today. Because stereoscopic pictures show up hidden depressions and hills that are not always apparent in the usual aerial photograph.

Grinding stereoscopic lenses, in fact, *all* highly-corrected lenses, is a delicate precision operation. In order to insure accurate measurements and to avoid uncontrolled expansion, lenses are tested in special *air conditioned* rooms . . . maintaining a constant temperature at all times.

Air conditioning is used similarly in making the famous Norden bombsight, in precision machining, and in many other industrial processes.

To do exacting war jobs like these, General Electric engineers have developed dependable air conditioning and industrial refrigeration equipment—equipment that had to be more efficient, more compact, and more flexible.

In the post-war period, the public will be enabled to buy not only now—but vastly improved air conditioning—from General Electric.

☆ BUY WAR BONDS ☆

General Electric Co., Air Conditioning and Commercial Refrigeration Divisions, Section 4310, Bloomfield, New Jersey

Air Conditioning by

GENERAL ELECTRIC

Hear the General Electric Radio Programs — THE HOUR OF CHARM — Sunday 10 P. M. E.W.T., NBC. — THE WORLD TODAY — News Every Weekday 6:45 P. M. E.W.T., CBS

You bet they're Tough

...making 'em tough is our business



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ARMOR PLATE FOR AIRCRAFT, TANKS, AND TANK RETRIEVERS	SPRINGS AND BUMPERS FOR PASSENGER CARS, TRUCKS, AND TRAILERS ASSEMBLED ON THE PACIFIC COAST
ARMOR SHIELDS FOR GUN MOUNTS	HIGHWAY GUARD RAILS AND ROAD-CENTER DIVIDERS
SPRINGS FOR JEEPS, HALF-TRACKS, AND TANK RETRIEVERS	AGRICULTURAL CULTIVATOR STEELS
FORGINGS FOR AIRCRAFT	OTHER PRODUCTS USING HEAT-TREATED, SPRING-STEEL
BOLO KNIVES FOR FILIPINO REGIMENTS	

"This award symbolizes your country's appreciation of the achievement of every man and woman in the United States Spring and Bumper Company"

ROBERT P. PATTERSON
Under Secretary of War July 24, 1942

Your sons (and ours) are fighting this war with the most modern, highly developed weapons, many of which are equipped with unbelievably tough armor plate. The ability of this armor to stop or deflect enemy fire means life itself to our fighting men.

We believe you are interested in the award of an Army-Navy "E" to the men and women of the United States Spring & Bumper Co., because much of the war equipment they have been making is armor plate for aircraft, tanks, tank retrievers and gun mounts.

United States Spring & Bumper Co. is the first armor plate manufacturer on the Pacific Coast. An important and difficult task was assigned those who labor at heat-treating furnaces—great straightening presses—the scores of arduous tasks necessary to the production of armor plate. They did their work so well that now all the workers at United States Spring & Bumper Co. proudly wear the Army-Navy "E" pins awarded to them by their country for their achievement.

And above our plant now flies the Army-Navy "E" flag—a constant reminder to all of us of our great obligation to the many who place such faith and confidence in our work.

★ *YES, it is YOUR WAR BONDS, and OURS, which will assure more—and still better—airplanes, tanks, guns, and other vital weapons for our fighting men whose need is so great.*

UNITED STATES SPRING AND BUMPER CO.

JOHN D. RAUEN, *President*

4951 ALCOA AVENUE • LOS ANGELES 11, CALIFORNIA





ALUMINUM
MAGNESIUM
AMPCO BRONZE
BRONZE
BRASS

WELLMAN
means
WELL-CAST

ONLY SKILL AND EXPERIENCE PRODUCE THE MASTERPIECE

GLASS BLOWING, one of the ancient crafts, requires the same high degree of alertness and physical fitness identified with a good foundryman. These are among the qualities contributing to the excellent quality of workmanship found in Wellman castings.

• Our long experience in Ampco Bronze, Well-Cast Magnesium, Brass, Bronze and heat treated Aluminum Alloys is available to your engineering department.

• Patterns of all sizes and kinds in metal or wood.

THE WELLMAN BRONZE & ALUMINUM COMPANY
General Offices: 2533 E 93rd St. • Cleveland 3, Ohio

★

WELLMAN

CASTINGS X-RAY INSPECTED



Lessons From The War

From our wartime experience we can say this: When peace comes, Americans will enjoy the comfort and convenience of many strange new devices which are today devoted to military purposes. They will not only extend our span of life but also make it pleasanter in many ways. The 4-plant facilities of The Weatherhead Company are prepared to help you build these peacetime products just as we've helped build America's cars, planes and refrigerators in the past. We offer you better designing than ever, much lowered production costs and a highly efficient service organization.

Look Ahead with

Weatherhead

THE WEATHERHEAD COMPANY, CLEVELAND, OHIO
Manufacturers of vital parts for the automotive, aviation, refrigeration and other key industries.

Plants: Cleveland, Columbia City, Ind., Los Angeles
Canada—St. Thomas, Ontario

Wings with sinews of STEEL TUBES

FOR AMERICA'S FLEDGLING FLYERS



FLEDGLING flyers need a plane that will take a beating—one that will stand the bumps, jerks and crazy contortions caused by inexperienced hands on the controls. Wings and engines must be securely mounted to absorb such shocks continuously. That's why so many basic trainers are built with SHELBY Aircraft Tubing to obtain the lightest, strongest construction possible.

Consolidated Vultee's basic trainer is one of a number of well-known trainer planes using SHELBY Seamless Aircraft Tubing for fuselage sections, engine mounts, and other parts requiring great strength. This construction withstands vibration, fatigue, and sudden strains and stresses.

Alloy steel tubing has the highest strength-weight ratio of any structural section under the severe stresses to which airplane structures are subjected. Today, too, in giant bombers and other combat planes, such vital parts as wing spars, fuselage struts, longerons, engine mounts, and landing gears are made from seamless alloy steel tubing.

No matter what type of plane you build there is a shape and size of SHELBY Aircraft Tubing for every modern aircraft. It is made to exact government specifications and must pass our own special tests before it is shipped. Write for our book giving complete details.

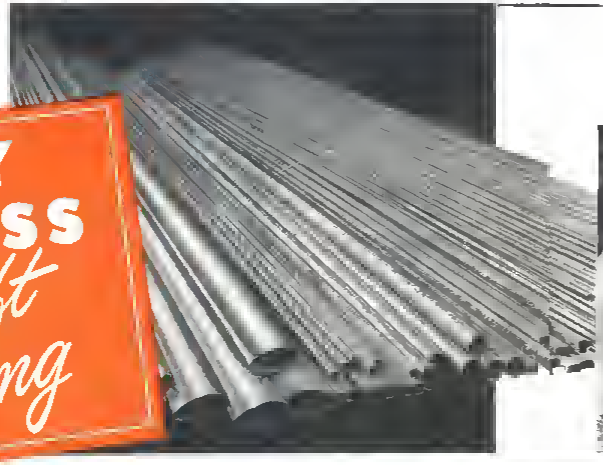
NATIONAL TUBE COMPANY

PITTSBURGH, PA.

Columbia Steel Company, San Francisco, Pacific Coast Distributors — United States Steel Export Company, New York

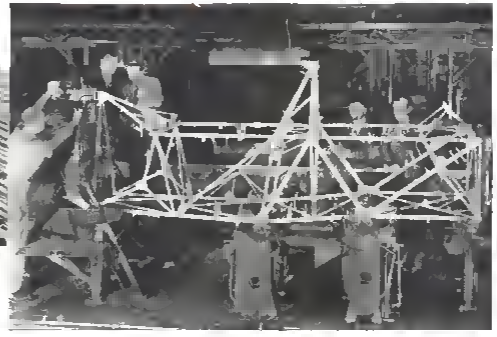
CONSOLIDATED VULTEE BASIC TRAINER — Vital parts built strong and light with the same SHELBY Aircraft Tubing that is used in fighters and bombers.

SHELBY SEAMLESS AIRCRAFT TUBING—round, oval, streamline, square, and rectangular.

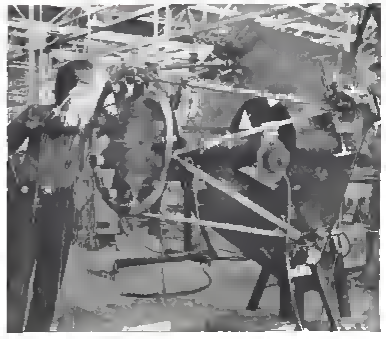


SHELBY SEAMLESS *Aircraft Tubing*

SEAMLESS STEEL TUBES welded together to form a homogeneous fuselage strongly braced to withstand strain from any angle.



ENGINE MOUNT of SHELBY Seamless Tubing assures great strength with high resistance to vibration and fatigue.



UNITED STATES STEEL

Introducing the Navy's first land-based bomber

1. PV-1—That's the U. S. Navy's name for the Vega Ventura. It's a nautical version of the smashing new twin-engine bomber that is making a flaming Hell out of German industrial centers in almost daily R. A. F. raids. These deep-bellied Navy PV-1's strike at sea. They swoop in low from the sky with torpedoes for marauding surface craft or "bath tub" depth charges for sub-busting.



2. Operating from land bases, the PV-1 is the first Navy bomber of its type to tackle the job of clearing Allied shipping lanes so that precious supplies may go through. Airfields on small island outposts are big enough for PV-1's and droppable fuel tanks give the planes range to blast the enemy. Experts say it may be the answer to the United Nations' No. 1 war problem—licking the enemy submarine.



3. Like the Ventura II, is versatile—capable of many jobs. Although designed primarily for bombing, 4000 h.p. can also be useful for towing targets for fast fighter plane practice, or for hauling troop laden gliders.

4. Bigger, faster and able to carry a larger load than the Lockheed Hudson which they closely resemble, the PV-2 and the Vega Ventura retain the same qualities of dependability. Single spar wing construction, 100% X-Rays of all stress parts and ruggedness of design are the qualities of stamina that permit these planes to go through so much—yet bring their fighting crews home safely.



A subsidiary of Lockheed

Vega

Aircraft Corporation

Copr. 1943, Lockheed Aircraft Corporation, Vega Aircraft Corporation, Burbank, Calif. Member Aircraft War Production Council, Inc.

For the WAR PROGRAM



27 BULLETINS on Ball Bearings — their use, installation and maintenance.

Available to Engineers, Designers, Draftsmen, Shop Men, Service Men and Maintenance Men.

Sent on your request; write, giving your title or position and name of company.

M R C LOAD COMPUTATION MANUAL is a 68 page booklet of methods for calculating loads on bearings. Sent free to mechanical engineers and draftsmen — send letter on your company stationery.

M-R-C BALL BEARINGS

MARLIN-ROCKWELL CORPORATION

Executive Offices: JAMESTOWN, N. Y.

alternating current increases range . . .



Back when electric power was mostly *direct current*, towns like Plainville still burned kerosene lamps. The distribution range of direct current was too limited.

Alternating current changed that . . . Westinghouse pioneered the change-over which expanded the economic range of power lines to 300 miles and over . . . brought light and energy to every crossroad and hamlet.

Now, history is being repeated in the growth of America's bomb power. As planes increase in size, range and ceiling, more and more electric power is needed. This involves a severe weight penalty with low-voltage *direct-current* systems.

As the answer to electric power requirements on these super-bombers, Westinghouse is helping to develop a high frequency *alternating-current* system. This system contributes to weight savings in generator and motor designs—effects further savings in distribution copper weight. With this increased power, bombers can hit harder, fly higher and farther.

* * *

By means of an A-C Calculating Board, Westinghouse engineers are analyzing the a-c requirements of modern bombers. Actual equipment has been developed to the point where a standard line of a-c equipment for aircraft will soon be available. So, if you need help on electrical equipment for aircraft, consult Westinghouse—builders of the first successful, 3-phase, 400 cycle equipment for aircraft. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., Dept. 7-N

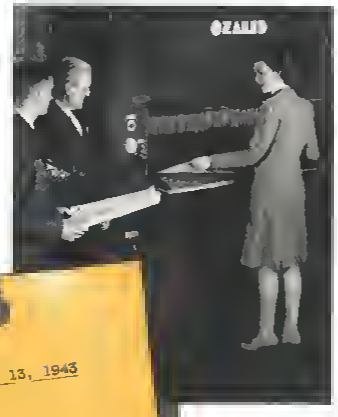
J-03199

Westinghouse

PLANTS IN 25 CITIES | OFFICES EVERYWHERE

Pioneering A-C Equipment for Aircraft

Why American Airlines ordered another Ozalid Machine



SALESMAN'S REPORT

Date August 13, 1943

Salesman J. A. Trevis
Company American Airlines, Inc
Address LaGuardia Airport, City, N Y
Interviewed Mr. P. Hayes, Engineering Dept
Mr Marvin Whitlock, Asst Chief Eng

The proof of the pudding lies in the eating
AMERICAN AIRLINES wants another machine — a faster model which will handle all of their reproduction work
They've had a Model F six months now and it's a "hit" with their Engineering Department and the men in the shop In the future, print production will be 100% Ozalid White-prints — no blueprints

Some of the things they like about Ozalid are

1. A A single operator can handle large-volume production
2. B. There are no chemical baths, driers, or plumbing connections. Consequently, an Ozalid machine is compact.. and may be installed in any corner of the drafting room.
3. C You can make prints having blue, black, or maroon lines on a white background in one continuous operation These are easier to read and check than blueprints
4. D You can make duplicate originals in the same manner as standard prints — without Van Dyke difficulties These may be substituted for valuable originals in subsequent print production .or they may be employed by the draftsman to eliminate retracing when making design changes.
5. E An Ozalid machine is a "servant" and not a "master" In other words, once you start a blueprint machine you have to keep feeding your tracings or you will waste paper With Ozalid, however, you don't have to keep pace with a paper roller You can use sheets cut to the size of your originals and feed as the demand arises.

All-in-all they're using Ozalid to reproduce engineering drawings, weather charts, flight analyses, office forms, and isometric drawings What's most important — they're saving time, labor, and materials
Please quote delivery on Model B with AA-1 priority.

P.S. Some Ozalid users on the Production Front

1. Grumman Aircraft Engineering Corp.
2. Hazeltine Electronics Corp
3. Republic Aviation Corporation
4. American District Telegraph Co.
5. Prudential Insurance Co. of America
6. International Telephone & Telegraph Corp
7. Carl L. Norden Inc
8. Ingersoll-Rand Company
9. American Stove Company
10. Pan-American Airways System
11. Cramp Shipbuilding Co.

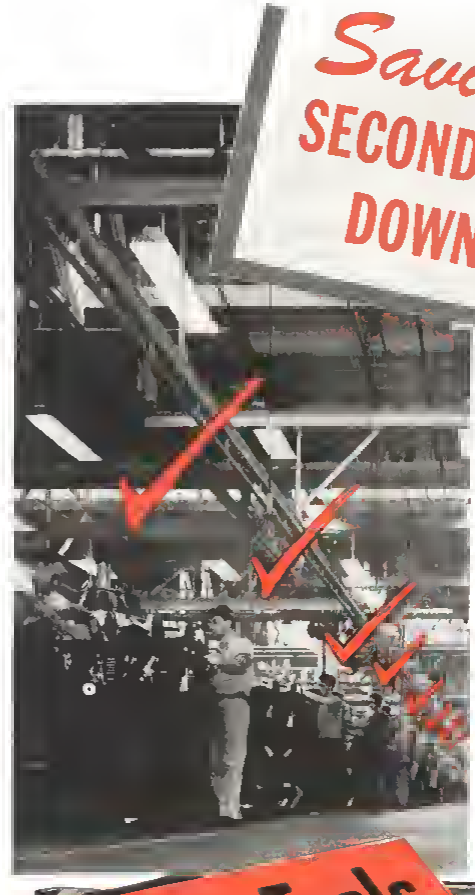
SEE FOR YOURSELF—SEND FOR CATALOG

OZALID PRODUCTS DIVISION

GENERAL ANILINE AND FILM CORPORATION

JOHNSON CITY, N. Y. ★ OZALID IN CANADA — HUGHES OWENS CO., LTD., MONTREAL

Sawing PRICELESS SECONDS . . . STRAIGHT DOWN THE LINE!



On every hand tool operation . . . *check and double check* . . . to make sure that the *right* tool, the *fastest* tool, is on the job. Worn tools, "slow tools" . . . tools poorly adapted to each specific application . . . waste time, skill, energy.

Straight down thousands of busy production and assembly lines Snap-on tools are the stand-out choice for speed, adaptability, accuracy. Their ease of application, solid grip and powerful leverage save time and energy, help promote a smooth, uninterrupted flow of work.

Eliminate the "bottle neckers" . . . replace with Snap-ons. 3000 modern Snap-on tools offer a wide selection for production and maintenance needs. Distributed through 35 factory branches located in key production centers. Write for catalog and address of nearest branch.

SNAP-ON TOOLS CORPORATION
8020-K 28th Avenue KENOSHA, WIS.



BACKGROUND FOR PRECISION

In seeking to conquer infinite space, the aircraft engine builder must master the infinitesimal.

He must achieve exquisite precision in the motor he makes

Such precision has been a habit with Allison for many years It has been our assignment to handle production problems requiring special skills

For here is wide experience in fine design.

Here is deep understanding of the strength and structure of metals

Here is meticulous machining.

These attributes today, combined with General Motors' faculty for mass manufacture, are giving substance to the purpose of our very being — our aim to build the finest aircraft engine the world knows.



★

BACK THE ATTACK—
WITH WAR BONDS

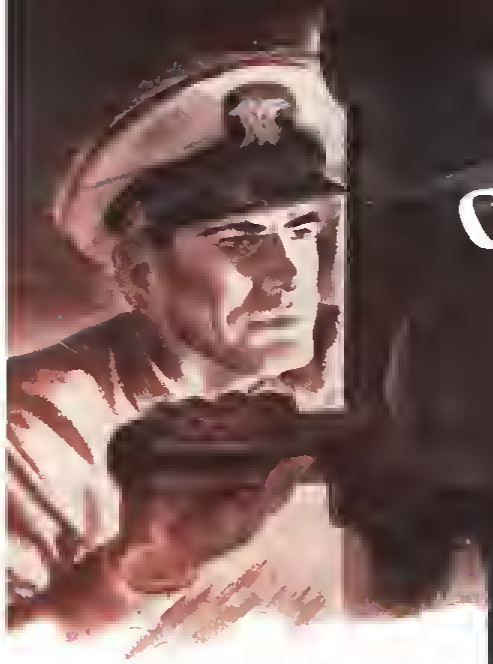
POWERED BY ALLISON *P-38 – Lightning • P-39 – Airacobra • P-40 – Warhawk • P-51 – Mustang*



Allison

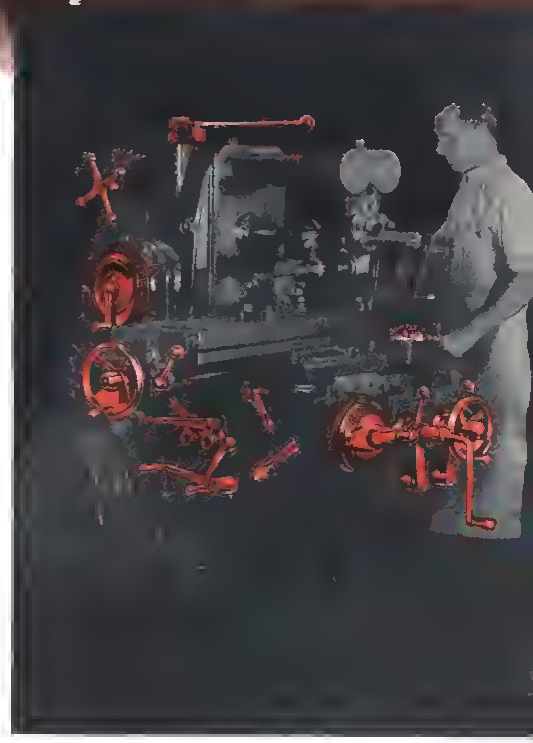
DIVISION OF GM GENERAL MOTORS

LIQUID-COOLED AIRCRAFT ENGINES



EVERY SUB COMMANDER KNOWS THE IMPORTANCE OF

Centralized Control



Instant response — unfailing action in every mechanical element of the ship — is vital to protect the lives of the crew as well as giving striking power to the submarine. From his station, the commander skillfully directs its performance through centralized control equipment.

★ ★ ★

The centralized controls of Milwaukee Milling Machines give the operator complete command of his machine — enable him to control its performance to the fine degree he demands for the full expression of his skill.

Speed and feed dials — all control levers within easy reach — the latter duplicated front and rear on plain and universal horizontal machines (model 2K and larger) — contribute to the sustained precision of Milwaukees, in the tool room or on the production line.





KEARNEY & TRECKER CORPORATION MILWAUKEE, WISCONSIN

Buy Victory with at least 10% in War Bonds!

Milwaukee MACHINE TOOLS

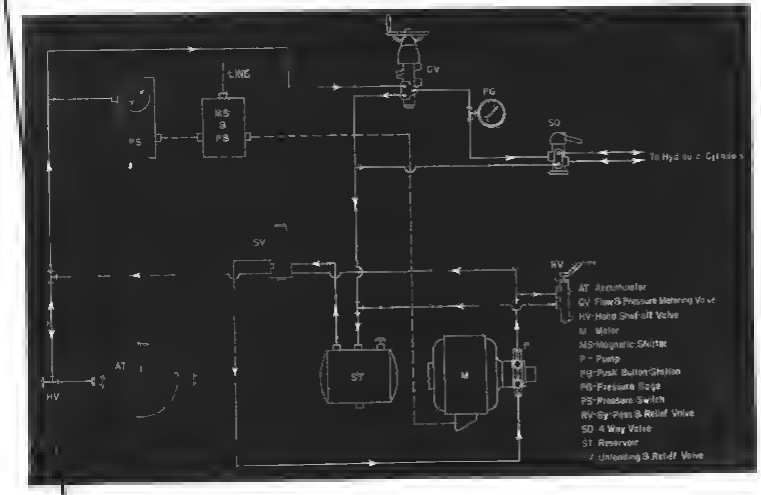
HYCON

High Pressure Hydraulic Systems

Can simplify and speed your production

- Complete test bench applications
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- High pressure jack operotion
- Hose, tubing and joint tests

Complete systems with accurately controlled pressures up to 3000 lb. per sq. in.



STANDARD EQUIPMENT FOR IMMEDIATE DELIVERY

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Catalogues on request.

Engineering Staff available for layout.

Complete units for testing component parts or functional operations can be assembled for use as fixed or portable installations.

The high pressures generated with compact units of light weight make them essential in aircraft production.

THE NEW YORK AIR BRAKE COMPANY

Hydraulic Division

420 Lexington Avenue, New York 17, N. Y.

Brakes On!

You can count on *G-E wing-flap drives* to get 'em downstairs

● Light and compact, but plenty tough—that describes G-E wing flap electric drives. Careful design, fine materials, and rigid tests—all have contributed to the building of G-E power packages that pack the punch you need, *when you need it.* Typical of the superior construction of this power package is its winding, which, because of a superior, new insulating technique, is practically indestructible even under the severest overloads.





LADISH

Quality

Drop Forgings

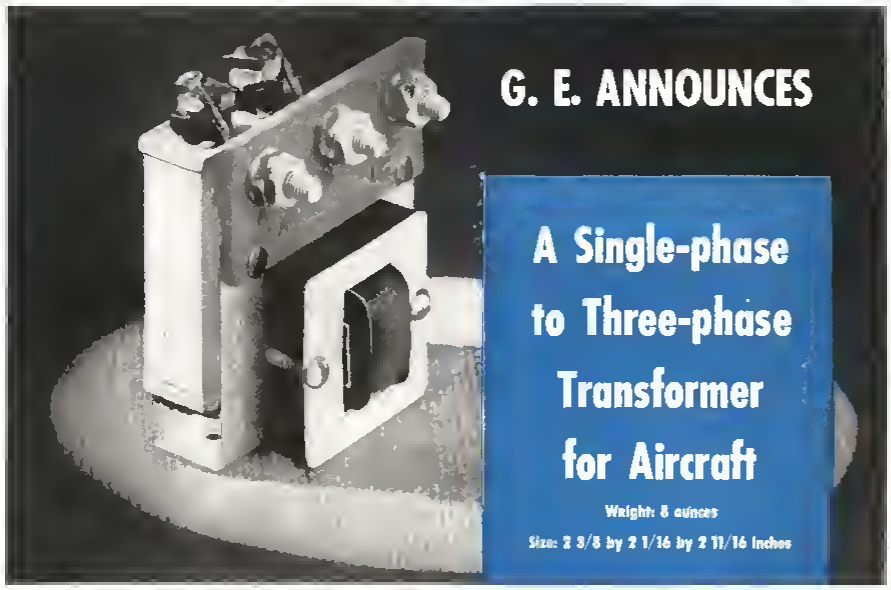
TO MARK PROGRESS

• Ladish facilities assure controlled quality forgings

ARMY NAVY

LADISH DROP FORGE CO.

CUDAHY [MILWAUKEE SUBURB] WISCONSIN



G. E. ANNOUNCES

A Single-phase to Three-phase Transformer for Aircraft

Weight: 8 ounces

Size: 2 3/8 by 2 1/16 by 2 11/16 inches

Provides correct supply for operation of G-E gyro instruments

This new G E transformer has been designed to operate one Type KB 1 (gyro horizon) and one Type KC-1 (directional gyro) aircraft instrument simultaneously By converting the 400 cycle 115 volt, single phase inverter output to three phase, it provides the power necessary for these two instruments it will not efficiently operate any other load

At normal temperature (25 C), the gyro motors will accelerate to full speed in 1 5 minutes

Sturdy construction. Exposed solder joints, mounting clamps, and terminals are protected against corrosion Core and coil are moisture and heat resistant Terminal board is strongly made, to resist shock and vibration

Long operating life assured. Operation is successful at any altitude, provided ventilation is sufficient, and throughout a wide range of temperatures (from −40 C to 70 C) A special Pyranol* capacitor ensures proper operating characteristics at low temperatures *General Electric, Schenectady, N. Y.*

*Reg U.S Pat Off.



IMPROVE AIRCRAFT ELECTRIC SYSTEMS WITH THESE G-E TRANSFORMERS



Three-phase to single-phase transformers



Two-phase to three-phase transformers



Autotransformers and ballasts for lighting indicators and instruments





Starting vibrator and ignition booster coils

KEEP POSTER—Send for your copy of "SPECIALTY TRANSFORMERS FOR AIRCRAFT." Keeps you up to date on G-E transformers for combat.

GENERAL ELECTRIC

To accurate shop assembly... add quick service adjustments!





● A 20% to 30% decrease in assembly time by use of a laminated shim is only half the story.

The same Laminum shim goes on from there .. and provides the machine with a means of easy, precision adjustment for wear, throughout field servicing

Many modern machines are equipped with Laminum shims at original assembly As for the others field and maintenance men usually want to install Laminum shims at the first take down They know it saves time, labor, material, and the machine itself Helps hold a machine at peak efficiency!

We cut Laminum shims to your blueprint specifications. Laminum shim stock, for repair or maintenance work, is obtainable from your mill supply dealer.

Send for this Application Chart It illustrates (with actual shop assembly photos) approved industrial uses for Laminum shims.

LAMINATED SHIM COMPANY
Incorporated
80 Union Street • Glenbrook, Conn

LAMINUM

THE SOLID SHIM THAT peels FOR ADJUSTMENT





ARGUS—With a Hundred Eyes That Never Sleep

British fighting men know it as the *Argus*, named for a character out of Greek mythology who had a hundred eyes that never sleep.

To Americans it is the *Forwarder*—the dependable, sturdy little utility cargo plane.

Officially designated by the U. S. Army as the UC-61A, this little sung member of the Fairchild airplane family is doing a heroic around-the-clock job on many a fighting front of the United Nations.

Getting precious medical supplies through to where they are needed in a hurry.

Carrying the ammunition to where it is needed most.

Setting down and taking off in tiny patches of clearing so small that larger planes could not use them.

Shuttling Army personnel between staff headquarters and where the shooting is.

Acting as the eyes of the Army in remote or inaccessible observation posts.

These and a hundred and one other routine duties well performed have long since earned for the trim little UC-61A the undying affection of men who have depended upon it to get them in and out of tight places.

Those who envision the universal use of airplanes after the war—both commercially and privately—may see in the four-place UC-61A the forerunner of tomorrow's taxi of the air. Another example of Fairchild's "touch of tomorrow in the planes of today."

BUY U. S. WAR BONDS AND STAMPS

Fairchild Aircraft *Division of Fairchild Engine & Airplane Corporation, Hagerstown, Maryland . . . Burlington, North Carolina*





it's Sure-Fire!

THIS HYDRAULIC MACHINE GUN CHARGER THAT'S HELPING AMERICA SCORE AGAINST THE AXIS



Interstate's mechanical gun charger also has outstanding advantages! It is exceptionally light. It is quickly and easily serviced. It is interchangeable (right or left). In addition, the pulley bracket and guard swivel 360 degrees, making it possible to charge the gun from any angle.

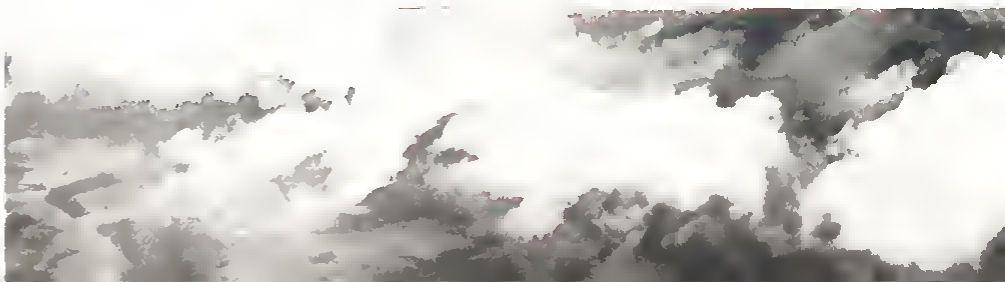
Designed by Interstate engineers to be lighter, more compact, more dependable . . . this hydraulic machine gun charger has proved its performance in the turrets of many a Martin Marauder . . . and in other ships that have helped knock Axis warbirds out of the sky.

This Interstate hydraulic unit has fewer parts, fits into smaller space, can be instantly attached and detached by hand . . . without the use of tools of any kind.

So successful has it proved in actual use on 30 and 50 calibre guns that Interstate has also developed a hydraulic charger for automatic cannon! This large unit, too, reflects the same exacting standards of workmanship that have won national recognition for Interstate Precision Units.

Interstate

AIRCRAFT AND ENGINEERING CORPORATION • EL SEGUNDO, CALIFORNIA







Kellett personnel are helping Curtiss P-40 Warhawks to crush the Axis in combat



Kellett precision made parts are flying with the famous Republic P-47 Thunderbolts



Kellett products accompany the powerful high speed Martin B-26 Marauders



...and take wing long range Consolidated B-24 Liberators over Germany

Pioneered the Past . . .
ENGINEERING THE FUTURE

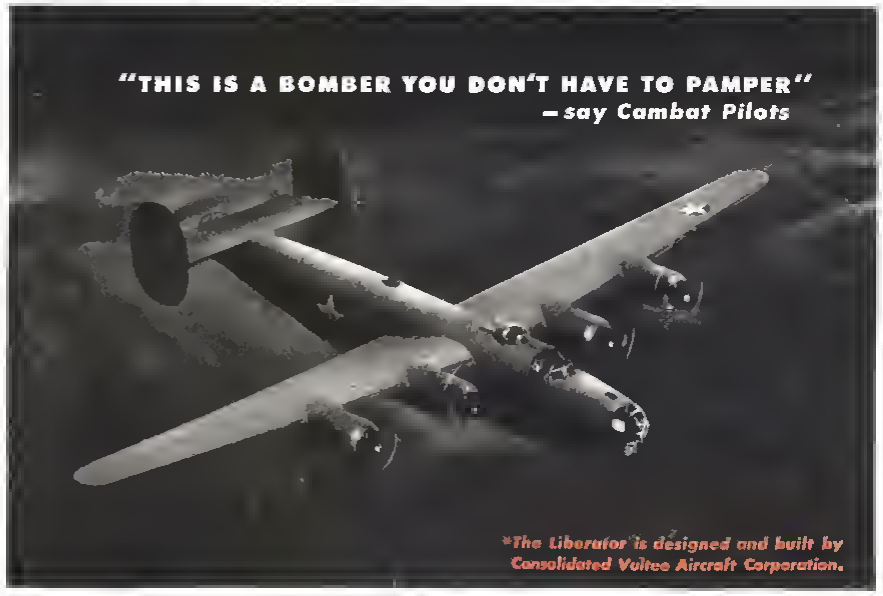
In addition to producing rotary wing aircraft for the armed forces, Kellett's two plants are supplying important parts requiring highest skill and aircraft manufacture 'know how" for our nation's best bombers and fighters . . . including the Consolidated B-24 Liberator, the Martin B-26 Marauder, the Republic P-47 Thunderbolt and the Curtiss P-40 Warhawk.

Meanwhile Kellett's *expanding* engineering staff continues the necessary development of *autogiros* and *helicopters* in cooperation with the United States Army Air Forces to meet present and future military requirements.

We look forward to postwar opportunities for Kellett Rotary Wing Aircraft to serve in patrolling electric power lines, oil pipe lines and in a variety of time-saving and cost cutting operations for industry, commerce, forestry and agriculture. Kellett Aircraft Corporation, Upper Darby (Philadelphia), Penna.

K E L L E T T

OLDEST ROTARY WING AIRCRAFT MANUFACTURING COMPANY



WE'RE PROUD TO HAVE A PART IN EQUIPPING THE RUGGED LIBERATOR

New proof comes in every day of the ruggedness of Consolidated Liberators. Reports tell of . . . precision daylight bombing without fighter escorts . . . power-diving to elude enemies . . . getting home with wings and control surfaces bullet riddled.

Part of the Liberator's ruggedness stems from the fact that with Winchester Cartridge Core Radiator Tubes their oil-cooling systems are safe from clogging, leaking, freezing or overheating.

Made of pure copper, with walls only 6/1000ths of an inch thick, Winchester Radiator Tubes, thanks to Winchester's COLD copper extrusion process, are seamless and so assembled that *their entire outer surface is cooling area.*

WINCHESTER RADIATOR TUBES RESIST CORROSION . . . DEFY BURSTING. Pure copper, Winchester Cartridge Core Tubes will not corrode under regular operating conditions. And they won't burst from freezing, because the coolant flows on the *outside* of the tubes. If freezing should compress a tube, causing a "set" and so restricting air flow, passing a rod through it restores it to normal shape.

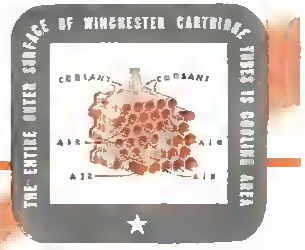
IF WOUNDED THEY QUICKLY FLY AGAIN. Pictures below show how to replace Winchester Cartridge Core Tubes should they be punctured in action or by accident. They explain, too, why millions of Winchester Cartridge Core Tubes are used to keep planes and tanks in constant action.

HARDER JOBS WANTED FOR THESE SENSATIONAL TUBES

No War Baby, Winchester Cartridge Core Tubes have 25 years of service behind their performance. They offer these spectacular features:

Of pure copper, thus corrosion-proof • Seamless,—safe against leaks • Coolant on outside —no damage from freezing • 1,728 cartridge core tubes per square foot • Avoid waste space in radiator assembly—minimum of solder • Permit tailoring radiator to fit any dimension or design • Provide up to 25% greater cooling per square foot than others.

WINCHESTER REPEATING ARMS COMPANY
New Haven, Connecticut
Division of WESTERN CARTRIDGE COMPANY



WINCHESTER
TRADE MARK
"On Guard for America Since 1866"



DAMAGED TUBES ARE PUSHED OUT
NEW TUBES ARE INSERTED
SOLDERING COMPLETES REPAIR

If out of your engineering knowledge, experience, research and skill you are contemplating a new fighting machine for Uncle Sam . . . are dreaming up a startling new post-war automobile, or similar product, write Radiator Division, Winchester Repeating Arms Company, New Haven, Connecticut.

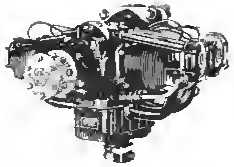
1943 . . . U.S. TANK CO., DIV. OF WESTERN CARTRIDGE CO.

Makin' the Grade... A LYCOMING FEATURE



THE DAY THE INSTRUCTOR SAYS—"GO AHEAD, KID, YOU'RE ON YOUR OWN."

No. 4 of a series sketched from life by Clayton Knight



Lycoming Model O-... rated 130 horsepower ... complete with pressure cooling baffles.

The power that helps make your first solo a success is apt to be Lycoming power. This power that carries you through primary and advance training is doubly important. It is what helps build in you the confidence every flyer must have. Every Lycoming must measure up to one standard . . . complete dependability

MAKERS OF Avco PRODUCTS

LYCOMING
AIRCRAFT ENGINES

LYCOMING DIV. — THE AVIATION CORPORATION, WILLIAMSPORT, PA.



At his FINGER TIPS . . .
an EYE for the EARS of his crewmen

In multiplane aircraft where interchangeability of the crew is impossible, intercommunication links each separate member into a single, inseparable unit. Thus each man's duty is coordinated with that of every other member. It's the TEAM-WORK that counts. Standair's Inter-call Signal Unit is a vital part of the communication system in modern observation and bomber aircraft. The red ***EYE*** says ***GET ON*** the inter-call system, enabling the operator to give instructions and reports to any one or all crew members. Standard Aircraft Products, Incorporated, are contractors to the U.S.A.A.F., the R.A.F., the R.C.A.F., and individual airplane manufacturers for this and various aircraft lighting equipment, aircraft power plant controls, other aircraft products and accessories.



INTER-CALL SIGNAL BOX
MADE BY STANDAIR

A.A.F. Drawing No. 43A12392
Standard Aircraft No. SA 2020 ●

Weight 5 oz. Overall length 3", width 1⅝", depth 2¾". Write or wire for engineering data sheets with detailed specifications.

"STANDARD Products—
Standard for the Industry"

STANDAIR

STANDARD AIRCRAFT PRODUCTS, INC.
DAYTON, OHIO

[illegible] OFFICES: [illegible] Products, Inc., 1631 Graybar Bldg., New York City
Hartwell Aviation Supply Co., 3417 Crenshaw Blvd., Los Angeles, Calif.
Hartwell Aviation Supply Co., Huron Building, Kansas City, Kansas
Hartwell Aviation Supply Co., 608 North St. Paul St., Dallas, Texas

SHAKEPROOF

COWL FASTENERS



designed for all... 3



1 PRODUCTION

Designed to speed assembly! Only 2 parts—spring unit, stud, and screw pin. Just one special tool needed. Shakeproof Cowl Fasteners assure fast, easy installation.



2 PERFORMANCE

Designed to give fighting aircraft the optimum in efficiency! Shakeproof Cowl Fasteners provide positive locking, exceptional endurance, and embody many important extra safety features.



3 SERVICE

Designed for quick, positive locking. Shakeproof Cowl Fasteners assure fast field maintenance and repair. Easy application speeds replacement of damaged parts and simplifies salvage work.

AVIATION DIVISION

SHAKEPROOF inc.

fastening Headquarters

Distributor of Shakeproof Products Manufactured by ILLINOIS TOOL WORKS
2501 North Keeler Avenue, Chicago 39, Illinois
Plants at Chicago and Elgin, Illinois — In Canada: Canada Illinois Tool, Ltd., Toronto, Canada

LOS ANGELES OFFICE
5600 W. Jefferson Blvd.
Los Angeles 16, Cal.

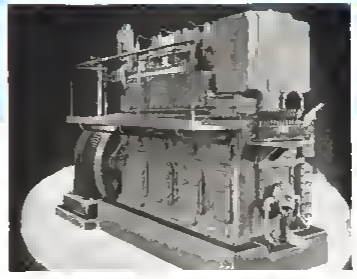
DETROIT OFFICE
2985 E. Grand Blvd.
Detroit 11, Mich.

FOR CANADIAN AIRCRAFT
T. Jeffery Limited
56 Illinois St. W., Toronto

FOR CANADIAN INDUSTRY
Canada Illinois Tools Ltd.
1 Front St. E., Toronto

PORUS ★ KROME

Speeds Breaking-in



On an order for 23d Diesel engines of 200 and 300 hp, Clark Bros. Co., Inc., were able to complete testing of *three engines each working day*, thanks to the speed with which full loads could be applied on PORUS-KROME cylinders. Similar results are obtainable in breaking in aircraft and automotive engines, thus speeding production and saving man hours.

Breaking-in an internal combustion engine had always been a tedious, time-consuming task before engine manufacturers started to PORUS-KROME process their cylinder bores. Ordinary cylinders frequently scuffed unless the engines were "nursed along" by very gradually stepping up the loads.

PORUS-KROME changed all that for Clark Bros. Co., Inc., when they adopted this processing for their diesel engine cylinders. Breaking-in periods have been greatly reduced because full loads can be applied very soon after these engines are placed on test. Rings quickly adapt themselves to the cylinders with very little wear and the engine is ready to go to work.

Ability to resist scuffing is inherent in PORUS-KROME. Minute, open pores in the chromium serve as reservoirs which hold and feed oil to the cylinder walls as needed, adding a means of assuring proper lubrication. This property, plus the natural hardness of chromium, helps reduce wear and multiplies engine life.

For literature giving additional information about PORUS-KROME, write Van der Horst Corporation of America, Cleveland 11, Ohio.

VAN DER HORST

PORUS ☆ KROME

Multiplies Engine Life

VAN DER HORST CORPORATION OF AMERICA CLEVELAND, O. OLEAN, N. Y.



"HALLOWELL" Work-Benches respond so readily to your demands, they're almost like soldiers trained to military discipline.

Line them up against a wall—they'll do a smart "right dress" for you—in a long, straight row. Then, if the need arises, they can be readily formed into small formations to handle special assignments. They have a military bearing too—they stand straight, they're firm and rigid—and they don't wiggle, bend or slouch. They'll serve long and well wherever they're needed. Why not put them to work for you? The "Hallowell" Shop Equipment Catalog will tell you how. Send for it today.

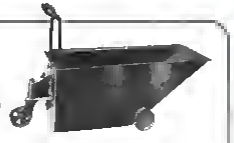


Fig. 1949. Hallowell Wood Work Bench with Back Board and Tie Bar Shipped Knocked Down

Since steel has gone to war, wood is taking over in many instances. You'll find "Hallowell" Wood Work Benches much better for the over restricted steel benches. Write for Bulletin 577 showing full line.

HALLOWELL

"HALLOWELL" TOTE BOX TRUCKS



For transporting any turnings to Whizzer. By using these specially designed tote box trucks, in place of old fashioned methods, you can save almost 100% of cutting oil formerly wasted—save time and labor too.

Over 40 Years in Business

STANDARD PRESSED STEEL CO.

JENKINTOWN, PENNA., BOX 566 • BRANCHES: BOSTON • DETROIT • INDIANAPOLIS • CHICAGO • ST. LOUIS • SAN FRANCISCO



BACK THE ATTACK—WITH WAR BONDS

The navigator's job is heavy with responsibilities. His is the task to put the ship over the target . . . and bring it safely home. Wire, too, plays an important part in getting the plane there and back.

Bombing crews and fighter pilots rely on the miles of wire which thread every plane. Wire for the "inter com," for landing and signalling lights, wire that relays the condition of engines and fuel. That is why dependability is a "must" in every type of wire and cable manufactured by Auto-Lite to meet the rigid demands of this exacting industry.

You can get complete details—in Form No. 838 covering Low Tension Cable; in Form No. C 503 covering Steelductor Cable, the High Tension Wire now used in the majority of America's fighting and bombing planes. We'd appreciate your making sure these valuable bulletins are in your file.

THE ELECTRIC AUTO-LITE COMPANY
SARNIA, ONT. *Wire Division* PORT HURON, MICH.

AUTO-LITE *AIRCRAFT* **WIRE and CABLE**

IN ITS 26 GREAT MANUFACTURING DIVISIONS, AUTO-LITE IS PRODUCING A LONG LIST OF ITEMS FOR AMERICA'S ARMED FORCES ON LAND, SEA AND IN THE AIR



ENGINES GET ACID INDIGESTION TOO!

WHEN AIRCRAFT ENGINES are being shipped, or lie idle in storage, they are subject to a peculiar malady. They get "acid indigestion!" Fuel residues left over from test runs form highly active acids that can corrode pistons, cylinder walls, bearings and other internal parts.

America's armed forces came face to face with this fact when they first began to ship aircraft engines to all parts of the globe. Immediately they sent out an urgent call for a preventive that would *effectively* stop corrosion and prevent rust caused by internal condensation. They got what they wanted.

Union Oil Company's answer was Stop Rust B which can deliver a motor in "factory-perfect" condition anywhere in the world. It meets specification AN VV-C-576b and is being used in large quantities by the armed forces today.

Stop Rust B has a top notch lubricating oil base. It is a preferential wetting agent that covers and protects metal surfaces completely. It won't drain off for months, stays put as long as the engine is idle. It neutralizes acids, keeps water away from metal surfaces. *It effectively prevents rust and corrosion!*

When drained out, Stop Rust B leaves no residue that could harm engines when put back into service. In fact, engines can be used immediately without flushing. The residue actually improves the lubricating oil—gives it a "break-in" quality.

So if you ship aircraft engines or other equipment that requires internal protection against rust and corrosion, get in touch with Union Oil Company by phone, wire, or letter. Stop Rust B can be supplied in 55-gallon barrels or in bulk.

UNION OIL COMPANY OF CALIFORNIA

LOS ANGELES

PORTLAND | SEATTLE | HONOLULU • SAN FRANCISCO | NEW YORK | JUNEAU | BALBOA • VANCOUVER





Smooth, Trouble-free COMMUTATION

One of the outstanding features of Louis Allis Direct Current motors is their smooth, dependable, trouble-free commutation

Larger commutator with a greater number of better insulated commutator bars—precision built and machined — reduces to minimum voltage increments between bars.

Over size rigid brush holders flour-grained carbon brushes —double insulated holder studs — assure smooth sliding non-sparking commutation.

These rugged heavily reinforced cast-iron and steel constructed motors are built to cooly deliver a constant flow of dependable power on the toughest jobs.

Available in a wide range of both electrical and mechanical modifications — a size and type for every industrial requirement



On your very next D C motor requirement specify by name — LOUIS ALLIS D C MOTOR — it's the motor to depend upon!

A copy of descriptive bulletin No 507 C will be sent upon request

THE LOUIS ALLIS CO., MILWAUKEE 7, WIS.

A Good Beginning...



Twelve of the Klixon Circuit Breakers installed in the Fleetwings BT-12 Trainer are shown on this panel

Photos Courtesy of Fleetwings Div. of Kaiser Cargo, Inc

Pilots get the feel of Spencer Circuit Breakers in the early days of training For, there, on the panel board of many basic trainers is a row of Spencer Breakers . . . the same type of breakers that are used on bombers, fighters, interceptors, torpedo planes and others. Pilots know what these breakers are for. They know the foolproof protection from overloaded wiring or short circuits these breakers give . . . protection without nuisance trip-outs . . . snap-acting performance at all altitudes . . . plus the important convenience of being able to reestablish circuits by merely pushing a button or switch.

It's a good beginning for pilots to learn the advantages of Klixon Circuit Breakers. And it's a good beginning when designers start putting these breakers in planes . . . a beginning of better circuit performance.

KLIXON

SPENCER THERMOSTAT COMPANY, ATTLEBORO, MASSACHUSETTS

This advertisement is one of a series which will appear in national magazines and newspapers this year as Consolidated's contribution toward a clearer public understanding of "aviation geography."



The Soviet worker in Yakutsk Siberia lives only 25 hours flying time from the Washington D. C. airport.

Try 37 hours flying time from Kunming City in the Chinese resident's home over the Chungking.

This million of this newspaper publisher in Cairns is only 63 hours flying time from Times Square, N. Y.

The African Ekoms lawyers Fribanks—13 hours flying time from the Chicago airport.

A 23-hour flight from Boston will get you in the office of this wholesale coffee dealer in Sao Paulo, Brazil.

The Pacific atoll where cliff Pan Islander lives is only 54 hours flying time from Denver.

No man on earth lives more than 60 hours from your local airport...

"A LOT OF THINGS are different in India than they are back home in Altoona," wrote a 19 year old sergeant in the U. S. Air Forces to his mother in Pennsylvania.

Never before in his life had this boy travelled beyond Pittsburgh — until he flew to India on a Liberator bomber.

To him — and hundreds of thousands of home-town American boys like him — India was a place "off there somewhere." He'd seen it in the newsreels and travelogue films. In his geography book he'd learned something about India's crops and minerals and untold riches, and the funny way the people dressed.

The world as it really is

Now his letters from overseas — telling how people talk and work and live in a strange land he never dreamed he'd see — *are penetrating into the lives and thinking of his family and friends in the town where he grew up.*

This is happening all over America today. And when our boys come home again — from India and China and Britain and Dutch Harbor and Australia and North Africa — they'll think of the world as they know it *really is.*

Not as isolated continents or separate hemispheres, but a clustering of nations whose *individual* welfare, in the peace to come, will depend upon the welfare of them *all.*

They know it can't be otherwise, when *no spot on earth is more than 60 hours' flying time from your local airport!*

In such a world, right now, we face the necessity of waging and winning a global war. Tomorrow — in a world shrunk still smaller because of ever swifter long range planes to come — we and all other nations must somehow contrive to get along together as neighbors.

Air power — for peace

There are bewildering problems ahead. But one thing is certain. The plane — by accelerating the interchange of men, mail, merchandise, ideas, culture, and beliefs — will help to bring about a greater understanding between the peoples of the earth.

And without understanding, there can be no lasting peace.

CONSOLIDATED VULTEE AIRCRAFT

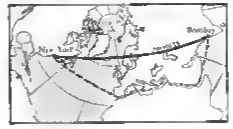


Your sales manager in Brisbane can fly to a meeting in San Francisco on short notice. Flying time 55 hours.



(Northern hemisphere projection centered on London)

A plane recently *flew the 14,000 air miles from London to Moscow on a special mission to the surprising return trip that same afternoon. Top speed 400 M.P.H.*



(Polar azimuthal equidistant projection)

Today's pioneer *with their tremendous speed and long flying range, need not follow old established trade routes. The 9400-mile sea route from New York to Bombay is about a 3 week voyage but the air route is only 7750 miles. Flying times 39 hours or less.*

CONSOLIDATED VULTEE AIRCRAFT CORPORATION

San Diego, Calif. • Vultee Field, Calif. • Fort Worth, Texas
New Orleans, La. • Nashville, Tenn. • Wayne, Mich.
Allentown, Pa. • Tucson, Ariz. • Elizabeth City, N. C.
Louisville, Ky. • Miami, Fla.

Member, Aircraft War Production Council

QUICK FACTS FOR AIR-MINDED READERS

Consolidated Vultee designed and perfected the long range Liberator bomber — was the first to turn out military bombers in volume production on a moving assembly line.

Because teamwork means more bombers and an earlier victory, the Consolidated-designed Liberator is also being produced by Ford, Douglas and North American.

Liberators and Catalinas have helped to provide a complete shore-to-shore air cover spanning the Atlantic as protection for convoys against Nazi submarines, according to joint statement by British Admiralty and Air Ministry.

All transport planes including the Liberator Express, are being equipped to carry standard stretchers for the evacuation of wounded, according to the Office of War Information.

To protect Australia's 11,000-mile coastline the Royal Australian Air Force uses Catalinas or ships that can report "journeys of 2000 miles or more as routine. Catalinas can remain in the air for thirty hours and can search Australia's remotest bases and return without refueling," according to the Commonwealth of Australia Department of Information.

At the end of 1943 the United States will have about 865 airports, each with paved runways of 3500 feet or more. This compares with less than 100 such airports in 1940.

There are 11 Consolidated Vultee plants in the United States. If these 11 plants could be put under a single roof, they would occupy a building 5 miles long and 5 city blocks wide.



In addition to *the Liberator bomber, Liberator Express transport planes and the Coronado and Catalina patrol bombers, Consolidated Vultee also builds dive bombers, trainers, and torpedo planes. Above, the Valiant — basic trainer widely used by the Army, Navy, and Marine Corps.*



"O.K. for take-off!" *Another huge Liberator bomber rolls off Consolidated Vultee's moving assembly lines into the hands of the test pilots. On every aerial battle front the speed, range, fire power, and precision bombing of the 4-engine Liberator is helping to transfer the Axis dream of victory into a nightmare.*

LIBERATOR (4-engine bomber) — **CORONADO, CATALINA,** (patrol bombers) — **P4Y** (anti-submarine plane) — **LIBERATOR EXPRESS** (transport) — **VALIANT** (basic trainer) — **VENGEANCE** (dive bomber) — **SENTINEL** ("Flying Jeep") — **RELIANT** (navigational trainer)



FOREIGN REPRESENTATIVES: The A B Wilkoms Machine Co, Ltd. Toronto Hamilton and Vancouver Canada ★ The Canadian Fairbanks-Morse Co Montreal Canada ★ Reginald M. Levy Melbourne Australia ★ Morris Black & Matheson Ltd Auckland, New Zealand Emilio Steuls & Cia Ltd., Sao Paulo and Rio de Janeiro, Brazil S A. ★ W A. Ramsey Ltd Honolulu, Hawaii

Slingshots
can kill giants

★ There are some 6,000 fittings in a four-engine bomber. That makes them a mighty important item.

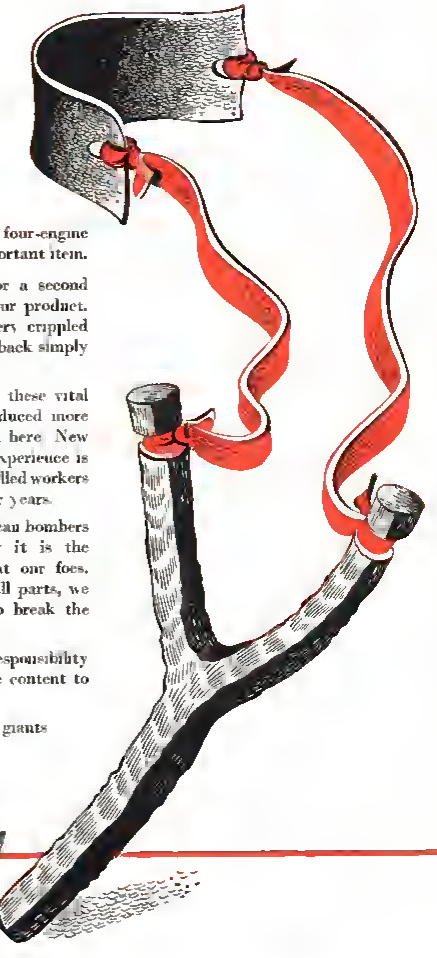
However, we never have thought for a second that the war cannot be won without our product. There is no idea in our minds that every crippled plane returning safely to its base comes back simply because its AFCO Fittings stood up.

But this we *do* believe: Nowhere are these vital "AN" tube, pipe and hose fittings produced more accurately, precisely and carefully than here. New machinery helps make that possible. Experience is another good reason, for many of our skilled workers have been turning out aircraft parts for years.

When word comes through . . . "American bombers are over Berlin again" . . . we know it is the blockbusters that are hitting hardest at our foes. But, along with other producers of small parts, we are glad that our effort has helped to break the morale of the enemy.

We will leave it up to those whose responsibility it is to build the mighty weapons. We are content to make *good fittings*.

We know that slingshots, too, can kill giants.



AFCO Fittings

NEW "AN" TUBE PIPE AND HOSE FITTINGS

FITTINGS OF QUALITY FOR PLANES OF WAR AND PEACE

The Aircraft Fitting Company • 1400 East 30th Street • Cleveland, Ohio

Waldes Truarc presents a significant advance in retaining rings.

It spreads or contracts without distortion; always retaining its perfectly fitting circular contour.



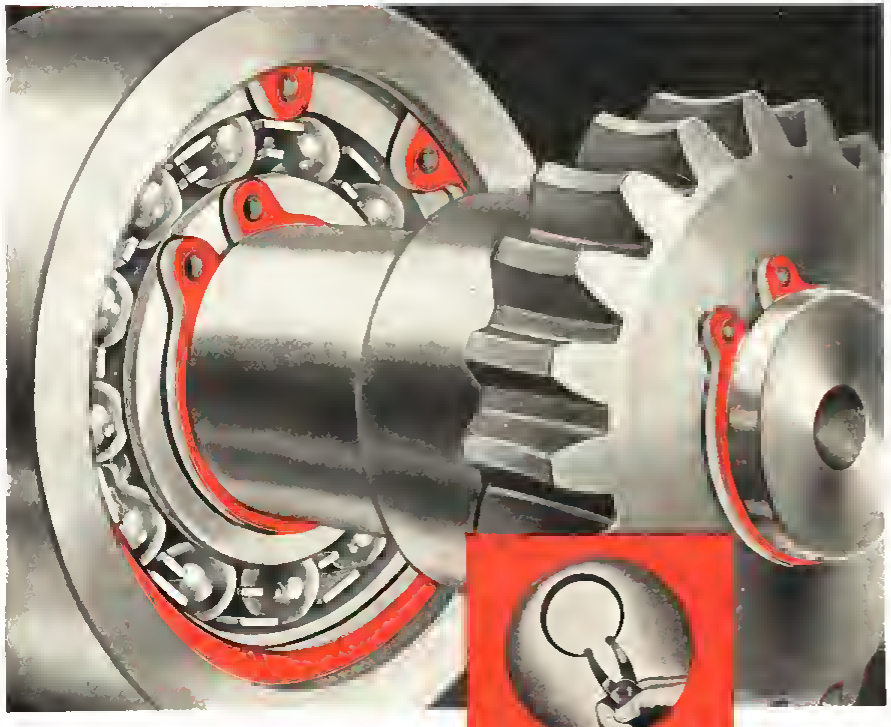
WALDES

TRUARC

RETAINING RING

For thrust-load fixing, and shaft and housing applications, Waldes Truarc provides distinct advantages over nuts and bolts or wedges and washers... it reduces dimension and weight... saves material... cuts manufacturing time... simplifies assembly and dis-assembly.

On request, we will gladly furnish samples and full data for your tests.



U. S. Pat. R. 1931
Sole Manufacturers U. S. A.

WALDES KOH-I-NOOR • INC ★ LONG ISLAND CITY, N. Y.



Official pic. copyright U. S. Army Air Forces

Meriam Manometers checking air speed indicators in the Instrument Inspection Laboratory of the Inspection Section, Wright Field



AIRCRAFT INSTRUMENTS ARE *Tested* WITH MERIAM MANOMETERS

THE aircraft industry is one of the largest users of Meriam Manometers and associated test equipment.

They are extensively employed at Army air fields in the United States and Possessions for checking and testing aircraft instruments, and in industry for testing aircraft engines, fuel and vacuum pumps, carburetor and other accessories.

In the illustration are shown two Meriam "8-in-1" Manometers (A-338). They are direct reading Well Type Manometers, each with an eight-sided scale selector, permitting the selection of proper scale for particular aircraft instrument being checked. They are widely used in both laboratory and field. Ask for Bulletin 22 on this instrument or Catalog C-10 on general line.

THE MERIAM COMPANY
1953 WEST 112TH STREET Since 1911 CLEVELAND 2, OHIO

MERIAM — THE INSTRUMENT PEOPLE

GLOBE STEEL TUBES

. . . Basic Material in the Construction of all Types of Military Equipment



Strength with minimum weight — uniformity of structure and characteristics — easy machine-ability — adaptability to a wide range of needs — these are a few of many advantages of Globe Steel Tubes that have given them an important place in the construction of all types of military equipment.

GLOBE STEEL TUBES CO. • Milwaukee 4, Wisconsin

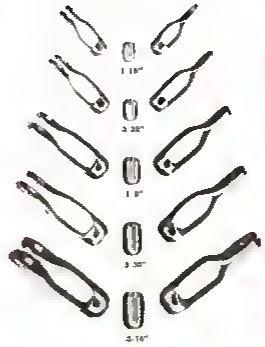
- Boiler & Pressure Tubes
- Condenser & Heat Exchanger Tubes
- Mechanical Tubing
- Stainless Tubes (Seamless)
- Stainless Tubes (Seamless)
- Gloweld Tubes (Welded Stainless)
- Globeron Tubes (Seamless Pure Iron)

GLOBE TUBES

Carbon — Alloy — Stainless Steels

Speed ASSEMBLY
Simplify SWAGING
with SOCKETYPE* CABLE TERMINALS

CHOICE OF CABLE SIZES



Other Cable sizes up to ¾"

PN

NEW FORK TYPE

OLD FORK TYPE

NEW EYE TYPE

OLD EYE TYPE

Approved as interchangeable with B & C types of present standard AN & NAF swaged cable terminals.

Specification sheet and folder available to industry personnel.



*Pat. Applied for.

ARMY NAVY

ESTABLISHED 1922

POULSEN & NARDON, INC.

LOS ANGELES 11, CALIFORNIA





Announcing the Formation of Fenn Aircraft

DIVISION OF FENN MANUFACTURING COMPANY

FOR over forty years the Fenn Manufacturing Company has been a leader in the production of Special Parts, Tools and Machines. With the recent tremendous expansion of the Aircraft Industry, brought about by the war, much of Fenn's Special Parts work has been for Airplane and Aircraft Engine builders.

It became apparent at the outset of the war that there was a real need for large and fast production of many kinds of precision made aircraft parts. The ability to work to close tolerances and to very exact specifications became an all important factor.

Fenn equipped their plant with many new precision machines to specialize in this kind of work. Skilled machinists, associated with Fenn for years, quickly adapted themselves to this exacting production.

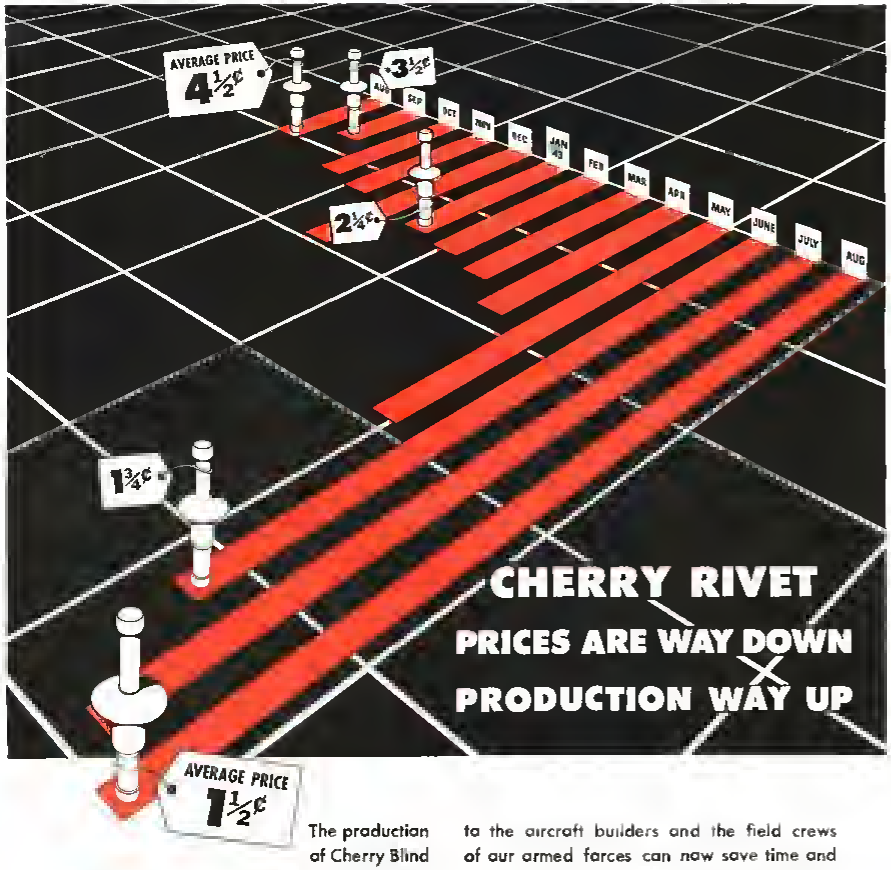
The volume of this work exceeded all expectations. For many months it has needed a plant of its own. And now it has it — Fenn Aircraft Division. This plant, located in New Britain, Connecticut, will specialize in the manufacture of aircraft subassemblies and parts; airplane motor parts and aircraft motor superchargers.

There is scarcely any limit to the diversity of parts that can now be made by Fenn Aircraft. A capable staff of engineers and designers working in direct cooperation with plane and engine builders, assures for the industry, now and after the war, a dependable source for sub-contract work.

Fenn Aircraft NEW BRITAIN CONNECTICUT

DIVISION OF FENN MANUFACTURING COMPANY

MANUFACTURERS OF AIRCRAFT SUBASSEMBLIES AND PARTS

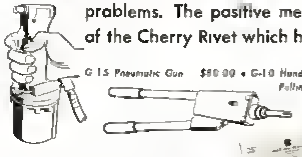


The production of Cherry Blind Rivets in August was five times greater than in August a year ago. In that time, the average price has dropped to ⅓ of its original level.

This means that you can now use Cherry Rivets to solve more design and production problems. The positive mechanical action of the Cherry Rivet which has proved itself to the aircraft builders and the field crews of our armed forces can now save time and money in an even wider range of uses.

Orders have increased faster than production, resulting in a large undelivered backlog. In spite of this, scheduling now permits partial delivery on new high priority orders within 30 days. Immediate delivery on emergency orders. Immediate delivery on tools.

CHERRY RIVETS, THEIR MANUFACTURE AND APPLICATION ARE COVERED BY U. S. PATENTS ISSUED AND PENDING



G-15 Pneumatic Gun $80.00 • G-10 Hand Operated Gun $16.50
Pulling heads extra as needed

GET COMPLETE STORY

Handbook A-43 tells how to use Cherry Rivets in blind or hard-to-get-at structures. New price list also available. Address Department A-110 Cherry Rivet Company, 231 Winston Street, Los Angeles 13, California



Cherry Rivet Company
LOS ANGELES, CALIFORNIA

William Tell had an easy target!





William Tell's achievement with arrow and apple was good enough for his time. But today's aerial marksmen are writing a brand new history of accuracy. Hitting an apple at 100 paces is good, but hitting a power house from five miles up is better yet.

Important factors in the almost incredible accuracy of American bombing are the manufacturers of electrical and navigational instruments. These manufacturers are producing instruments of exceptional precision. The Boes-made Astro Compass for celestial navigation, shown at left, is a good example. So, too, are the bomb release switches, the Compass Swinging Sight, and the electrical indicating instruments that comprise our production for Victory. While all of them are now employed at the business of destruction, it is comforting to reflect that they will some day serve the skyways of a world again at peace.

The W. W. BOES Co., Dayton, Ohio.

MANUFACTURERS OF ELECTRICAL AND NAVIGATIONAL INSTRUMENTS FOR AIRCRAFT

LET'S PAY for the WEAPONS WE'RE BUILDING—WITH BONDS!

Announcing Production of

ALL-ALUMINUM ALLOY AIRCRAFT ENGINE PRESTONE RADIATORS and OIL COOLERS for Army Air Forces

SAVING ⅔ THE WEIGHT

of copper units of the same size and rating

CLIFFORD MANUFACTURING CO.

564 EAST FIRST STREET, BOSTON

Producers of HYDRON Metallic Bellows and bellows assemblies for all types of aircraft controls and instruments



The Plywood Airplane is a *TEGO-BONDED* Airplane

THE COMPLETE RESIN BONDING LINE AT WORK

THE modern plywood plane, such as the De Havilland Mosquito pictured here, resulted directly from the introduction of TEGO Resin Film in 1935. Use of this pioneer synthetic resin adhesive first enabled woodworkers to make weather-proof, fungus-proof, boil-proof aircraft plywood. TEGO also solved the problem of producing highest quality aircraft plywood in large quantities quickly.

Today, as for many years past, TEGO-bonded plywood is the accepted standard for aeronautical plywood meeting the rigid requirements of the U. S. Army and Navy Specifications. No other resin adhesive can match the long record of outstanding performance which TEGO has demonstrated. In the construction of practically every plywood plane TEGO-bonded plywood is widely employed.

Tego Resin Film

TEGO Resin Film, a phenol formaldehyde type resin in sheet form for hot pressing, has been, since its introduction in 1935, the standard for highest quality, completely waterproof, hard wood plywood.

Its advantages include unquestioned durability and strength of bond, uniformity of spread, cleanliness and precision of operation, absence of glue water, freedom from surface penetration, and speed of output.

Today TEGO Resin Film can add to these advantages a length, diversity and severity of service unapproached by any other comparable plywood adhesive.

The Uformites

UFORMITE 430 is a urea formaldehyde resin adhesive in liquid form. It has extended the advantages of resin adhesives in lower cost fields and is currently finding widespread use in vital war and essential civilian applications.

UFORMITE 500 is a similar resin supplied as a dry, water dispersible, powder. UFORMITE 130 and 500 are used for both hot and cold-setting work.

UFORMITE CB-551, a cold bonding ready to use urea formaldehyde resin with catalyst, is easy to use, gives bonds far superior to older cold-setting glues. Complies fully with AN C-8, 52 C-11 and other aircraft and marine specifications.

The Amberlites

The AMBERLITES are phenol formaldehyde type resin adhesives, supplied in powder or liquid form. Each AMBERLITE is designed specifically for use in hot pressing several types of plywood.

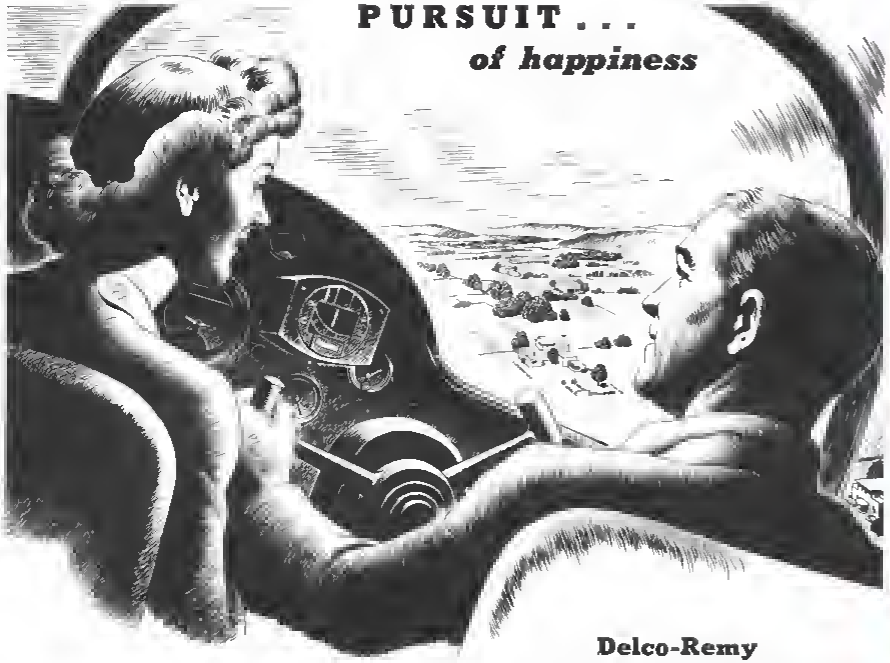
AMBERLITE PR 51—DFPA approved adhesive in dry powder form, for use in EXT plywood.

AMBERLITE PR 14—This resin adhesive, supplied in powder form, is widely employed in the manufacture of aeronautical and marine plywood, and for molded "rubber bag" plywood.

AMBERLITE PR 50—A liquid type adhesive for impregnating, compregnating plywood.

THE RESINOUS PRODUCTS & CHEMICAL COMPANY

WASHINGTON SQUARE, PHILADELPHIA, PA.



PURSUIT . . .
of happiness

Delco-Remy
Aircraft Electrical Equipment

In free skies where no enemy comes diving out of the sun, boys who now pilot fighter planes will find new meaning, new joy in flying. Their ships will incorporate safety equipment and engineering features developed in the laboratory of war. ¶ Delco-Remy aircraft electrical equipment is today serving on bombers and pursuit planes. It will be adapted in peace to commercial plane requirements, while the technical knowledge gained in wartime assignments will be applied to improving Delco-Remy starting, lighting and ignition for light planes. ¶ More than half of Delco-Remy's facilities are now engaged in manufacturing aircraft electrical units, precision parts and products for the aircraft industry.

ARMY-E-NAVY **DELCO-REMY** BACK THE ATTACK WITH WAR BONDS

DIVISION, GENERAL MOTORS CORPORATION

HANSEN

AIR HOSE COUPLINGS

FOR DISTINGUISHED AIR SERVICE

HANSEN MFG. CO.

Hansen air hose couplings have received international acclaim for their remarkable day in and day out performance under every conceivable condition

Regardless of whether it's a small plant or a large industrial factory, if you use air you need Hansen couplings because they will save money time and effort and increase production beyond your present peak.

For instance in aircraft plants where today's production record will probably be beaten by tomorrow's output Hansen couplings are used in approximately 95% of these plants They're first choice because they outperform the field and are one of the very important factors in piling up aviation's phenomenal production records

We would be glad to send you our catalog covering the complete Hansen Air line equipment. Write today

THE HANSEN MANUFACTURING CO.
1786 EAST 27th STREET • CLEVELAND, OHIO



"TAMING THE WILD"

THE last frontier of the vast Northlands has been opened. Civilization and Man's ingenuity are spreading their wings to the far reaches of these rugged lands of Canada and Alaska. The Wild is being tamed.

The men and women of Jacobs are very proud of the part their products have played in this pioneering. For a decade, planes powered by Jacobs have been carrying men and supplies into the "Bush Country," helping to open it. The Alcan Highway—that great achievement of modern engineering and human energy—has recently been completed, and Jacobs powered planes carried in much of the equipment and supplies for its construction.

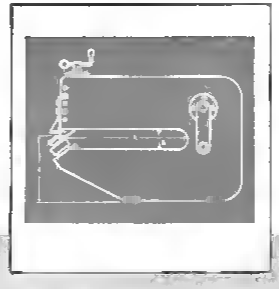
Today, military needs swallow all aircraft production, and Jacobs' output, multiplied many times, is powering the majority of the Bomber Pilot Trainers of the huge U. S. Army Air Forces' training program and Canada's Commonwealth Air Training Plan. After Victory is won, however, airplanes will make the rich resources of the Northwest available for the civilized progress of the World, and Jacobs Engines, with new efficiency and new economy, will be ready to blaze the way.

JACOBS AIRCRAFT Engines

POTTSTOWN • PENNSYLVANIA • U. S. A.



QUICKWORK-WHITING Announces— A NEW HAND-OPERATED ROTARY SHEAR



Over all dimensions 24" x 30½" x 14"
The Quickwork Model 06 Rotary Shear bolts to any bench or mobile worktable. Deep 18" throat makes it possible to handle wide sheets.

Here is a fast, accurate tool for trimming light sheets up to 16-gauge mild steel. Light-weight and operated by hand, this machine is readily installed and ready for operation by simply mounting to bench or mobile unit for portable use.

In design, this Model 06 has many distinct advantages. It incorporates the unique Quickwork shearing principle used in the large power operated Quickwork Rotary Shears. In spite of the fact that it has inclined plane cutter shafts, there are no projections beyond the upper cutter. Even the stripper may be removed to facilitate close work or for cutting on short radii. Deep throat, 18 in., permits handling of large sheets.

Power Equipment—Special Attachments—Information on special attachments or power equipment for use with the Model 06 is available on request.

QUICKWORK-WHITING DIVISION

WHITING CORPORATION

15623 LATHROP AVENUE, HARVEY, ILL.

The Aviation Industry Is Served by Whiting Corporation with Cranes • Machines • and Matched Maintenance and Handling Equipment



A·S·P

PRESENTS

A NEW SELF-SEALING COUPLING

FOR HYDRAULIC AIRCRAFT UNITS

A disconnecting, self-sealing coupling that really works One prominent aircraft manufacturer writes that he has "found that this coupling is of much sturdier construction and more fool-proof design than present equipment The American Screw Products coupling has consistently withstood 2500 psi with only finger tightening. A sample coupling purposely crush-tightened with a long-handled wrench did not leak upon disconnection, or reassembly. The hydraulics section of Engineering has granted unqualified approval of this coupling.'

These features are important Heavier construction of the high strength aluminum body prevents distortion under very severe handling conditions, jamming of spring-loaded shut off valve is prevented Light weight cast phenolic poppets are positive-sealing in action Springs are made of finest hear-treated steel Synthetic gasket provides leak-proof connection when coupled for service Available with AC or AN threads Write for full details and prices

AMERICAN SCREW PRODUCTS

7008 AVALON BOULEVARD • LOS ANGELES • CALIFORNIA



The "grasshoppers" of the air force: the observation, reconnaissance, and training planes need and get Aero-Quality Lumarith for their windshields and cockpit enclosures. It provides the important combination of superior light transmission (up to 95%) and high impact strength. ★ ★ Lumarith is lightweight and shatterproof . . . stands the strain of violent air pressure changes and bumpy landings. Through a process of light stabilization, it gains improved weathering qualities. ★ ★ Lumarith plastics are "traveling light" in military planes all over the world. In the shape of grommets, control dials, grips, ammunition rollers, first aid kits, ventilator tubes, sight gauges, etc , they are helping to cut down weight and thereby raise altitude ceilings. ★ ★ We invite you to consult us on present or future problems in plastics. ★ ★ Celanese Celluloid Corporation, *The First Name in Plastics*, a division of Celanese Corporation of America, 180 Madison Ave., New York City 16, *Trade Marks Reg. U.S. Pat. Off.

Aero Quality

LUMARITH

a Celanese Plastic*



Bull in a China Shop—



AND HOW HE WAS TAMED

Offhand, the thought of putting a delicate radio set in a lunging, thundering war tank is reminiscent of the dainty china and the proverbial bull.

You expect parts and pieces to start flying.

But they don't. And the story of how these sensitive instruments are able to stand war's mauling—jarring shocks, the concussion of artillery fire, electrical interference, tropic heat and Arctic blizzard—is partially the story of Delco Radio's experience in automotive radio. For years, Delco Radio technicians have been tackling and licking the parallel problems that once made automotive radio impossible. And as a result, when war struck, Delco Radio had a head-start on these old foes of "radio in transit."

Refining and extending its manufacturing and testing methods in cooperation with military technicians, Delco Radio has helped to provide practical radio communication for war vehicles . . . in large quantity and on time. Thanks largely to years of pioneering research during prewar times, the old foes that once wrought havoc with radio reception in motor vehicles have been subdued. Delco Radio Division, General Motors Corporation, Kokomo, Indiana.

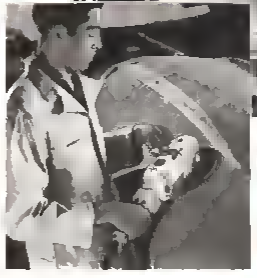
Back the Attack—
WITH WAR BONDS

Delco Radio
DIVISION OF
GENERAL MOTORS

Pushing Plane Production into HIGH



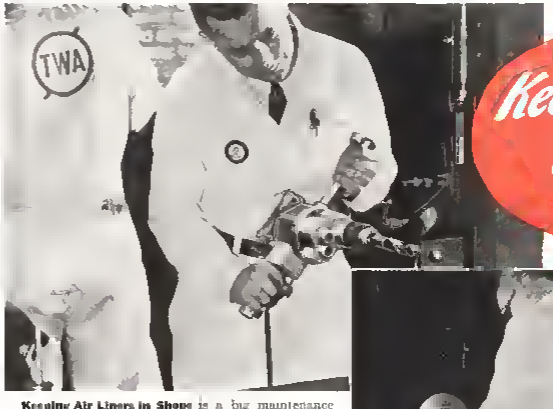
Throughout the aircraft industry, Black & Decker Portable Electric Tools are helping to speed up warplane production. They are drilling, tapping, driving screws, setting studs, sanding, grinding, cutting metal . . . doing many important production jobs *faster* and *better*. Here are a few of the jobs Black & Decker Tools—the *most used* tools in the entire aircraft industry—are doing now.



Holgun Speeds Drilling on final assembly line for deadly pursuit planes. B & D Drills—including the famous Holgun—come in ¼" to 1½" capacities, with choice of spindle speeds and handles.

In Metals, Wood or Plastics, husky B & D Tools are helping speed production jobs—on aircraft parts sub-assemblies, engines and armament. Here Heavy Duty Sander is "finishing" plywood fuselage.

Keeping Planes in Shape to FLY



Keeping Air Liners in Shape is a big maintenance job for Black & Decker Electric Tools at TWA. This Heavy Duty Drill is a many-purpose tool at the airline base, doing all kinds of servicing jobs.



Maintenance Department Standby is the Black & Decker Bench Grinder. Used for all sorts of servicing jobs in aircraft maintenance shops the world over, this Grinder helps keep big TWA ships flying.

In aircraft maintenance and service shops everywhere, Black & Decker Portable Electric Tools help to "keep 'em flying." At home, servicing giant transport planes; at the battle front, servicing America's warplanes B & D Drills and Bench Grinders, Valve Refacers and Valve Seat Grinders are used every day to help maintain the largest air fleets the world has ever known.

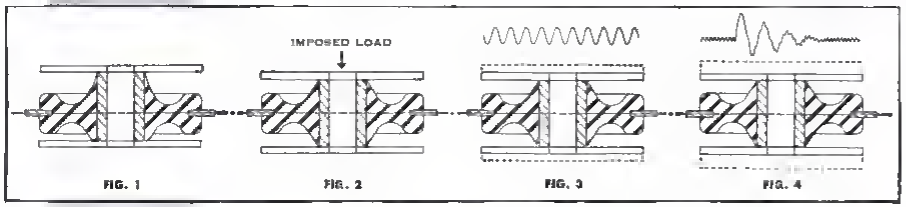
Where Can You Save More Time
with more Black & Decker Tools? Get in touch with your B & D Distributor for help on tooling problems. He's your dependable, convenient source of supply. The Black & Decker Mfg. Co., 738 Penna. Ave., Towson, Md.

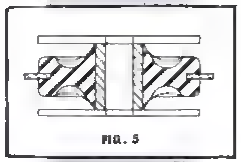


LEADING DISTRIBUTORS EVERYWHERE SELL
Black & Decker
PORTABLE ELECTRIC **TOOLS**

Precise Load Rating OF LORD MOUNTINGS

RESULTS IN HIGH EFFICIENCY OF VIBRATION ISOLATION





Operation of Plate Form Mountings

ALL Lord Mountings are designed to operate on the principle of having the rubber "stressed in shear" when load is applied in the direction of the main axis of the mounting. This mounting design provides the required softness and deflection in the direction of the disturbing forces, and stability or resistance to movement in directions normal to the major thrusts, thereby obtaining the highest degree of vibration isolation efficiency.

The proper deflection of a mounting under a given static load is of paramount importance in selecting a suitable means of flexible suspension, and every Lord Mounting is designed to have a definite static deflection under its rated load. Lord Plate Form Mountings (non-snubbing type) are designed to deflect 1/16 inch when rated load is applied.

Illustrations above show a Lord Plate Form Mounting in the various positions it assumes while static or in action:

Fig. 1—Under no load (as shipped from factory). Note extension of center sleeve. Fig. 2—Under rated load, note that center sleeve has deflected 1/16 inch. Fig. 3—Operating in zone of free shear action under normal vibration. Fig. 4—Operating momentarily under sudden shock or in zone of resonance. *(see footnote)

Lord Plate Form Mountings are designed to cover a wide range of applications in every field of industry. They are made in four shapes (round, square, diamond, and holder types) and four sizes, with load ratings ranging from a few ounces to 300 pounds. Load ratings of each size can be varied by:

1—Utilizing different rubber compounds of varying degrees of stiffness to meet specific spring rate requirements.

2—Changing dimensions of rubber element at flexing point. (See Illustration No. 5)

The remarkable efficiency of Lord Plate Form Mountings is due to the accuracy, precision, and uniform quality of manufacture.

Various factors must be considered when choosing mountings for individual installations. Through proper mounting selection, isolation efficiencies ranging from 75% to 85% reduction of disturbing forces may be expected, although reductions up to 97% are not unusual on equipment operating at very high frequency.

Write for bulletins 103 and 104. They give complete information on all Lord Mountings as well as an engineering discussion on vibration control. Better still, call in a Lord vibration engineer for consultation on your design problems. There is no obligation.

**Where frequent shock loads or operation in resonance zone are encountered, the use of Lord Vertical Snubbing Type Mountings is recommended. See Bulletin 103.*

INVEST TODAY IN BONDS FOR VICTORY

LORD MANUFACTURING COMPANY . . . ERIE, PENNSYLVANIA

Originators of Shear Type Bonded Rubber Mountings

SALES REPRESENTATIVES: NEW YORK, 280 Madison Ave. · CHICAGO, 520 N. Michigan Ave. · DETROIT, 2310 Woodward Ave. · BURBANK, CAL., 245 E. Olive Ave.



THESE new instruments are specially designed for the measurement of voltage and current in battery and battery-charging circuits on naval aircraft. They meet all Navy specifications.

Thinness is obtained by the internal-pivot construction. But this design affords much more than thinness. The elements, on account of their high torque and large-radius pivots, are well able to *withstand vibration.* High torque combined with a light-weight moving element results in fast response. Good damping makes for ease and accuracy of reading. Large clearances ensure reliable operation.

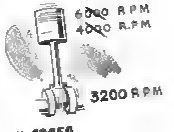
All these features add up to a high factor of merit and all-round fine performance.

For complete information on ratings, prices, dimensions, and specifications, ask the nearest G-E office for Bulletin GEA-4117; Or write to General Electric, Schenectady, N. Y.

GENERAL ELECTRIC

AUXILIARY *Electric Power*

ASSURES DEPENDABLE PERFORMANCE OF VITAL AIRCRAFT ACCESSORIES



• LOW SPEED

From the start to the finish of a bombing mission it is essential that all vital accessories perform efficiently.

The Andover Auxiliary Power Unit stands ready at all times to furnish constant, dependable auxiliary electric power for the operation of these accessories.



• LIGHT WEIGHT

Moreover, the Andover Auxiliary Power Unit also presents three important features that make it advantageous in modern aircraft. Its *light weight,* only 116 pounds complete with generator, means more fuel or battle equipment can be carried. Its *compact size* permits its installation in a small space in any one of a number of places and its *low speed* insures dependability and minimum of maintenance.



• COMPACT SIZE

Andover Auxiliary Power Units are increasing the efficiency of aircraft in world combat today and will play an important part in industry tomorrow wherever portable electric power is needed.

The Andover Auxiliary Power Plant consists of a two-cylinder air-cooled engine driving a 28 5-volt generator supplying a continuous power output of 5 K. W with a peak load of 7½ K. W Its complete weight with generator is only 116 lbs





Andover
AUXILIARY POWER

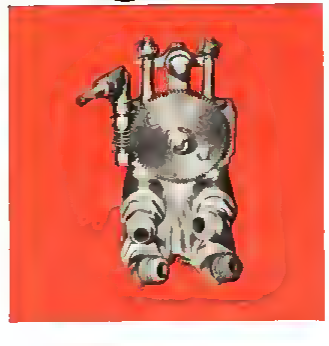
ANDOVER MOTORS CORPORATION • ELMIRA, N. Y.

WHOLLY-OWNED SUBSIDIARY OF ANDOVER RENT AVIATION CORPORATION



ARMY E NAVY

STUFF THAT Stars ARE MADE OF



We manufacture aircraft hydraulic units of high precision. One of these intricate small controls is the flap stop valve for Army pursuit planes. Because we were able to build units like these in both quantity and quality VARD received the Army-Navy E

Without relaxing in any way our standard of precision, VARD has stepped up production since the award till our daily output of these valves is now plus 300%.

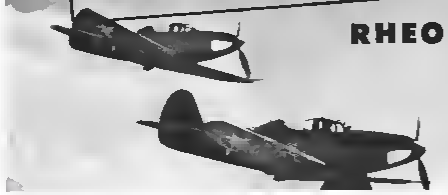
On this record we have just been given the Army-Navy E with Star

VARD INC.

PASADENA, CALIFORNIA

OHMITE

RHEOSTATS and RESISTORS



In the Fight with Bell Airacobra (P-39)



Ohmite Resistor ready for [illegible] lation in a Bell Airacobra (P-39)

They re *both* veterans of the air . . . ready for battle . . . anytime . . anywhere! That's why you find Ohmite Resistors and Rheostats in this famous fighter, the Bell Airacobra . . and in other fine combat, bomber, training and transport planes.

These dependable resistance units have pioneered the airways and "earned their wings" through years of aircraft service under all types of operating conditions. Today, they re on duty on every front. Because of this, they will be even better qualified to serve the peacetime needs of the aircraft industry, tomorrow. *Approved types for Army and Navy Aircraft.*

OHMITE MANUFACTURING COMPANY
4946 FLOURNOY STREET • CHICAGO 44, ILL.

Send for Catalog and Engineering Manual No. 40

Write on company letterhead for this helpful, 96-page guide in the selection and application of rheostats, resistors, tap switches, chokes and attenuators for all types of applications



Ohmite Rheostat [illegible] in Anti-Icer Control



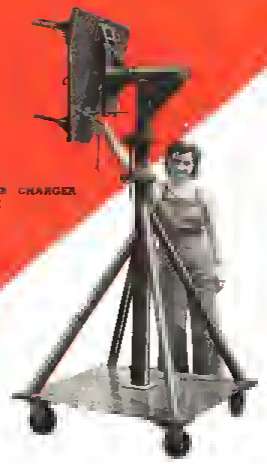
CRANE SLING



PROPELLER INSTALLATION CRANE



[illegible]



SUPER CHARGER JACK

Special Tools
FOR
Plane Builders!

Engineered to Speed Production

Here are just a few of the many specially engineered tools we are fabricating to save time and labor for builders of military aircraft and their sub-contractors. Besides such welded equipment we are also equipped and staffed to make non-metallic jigs and forms and both welded metal and moulded plywood plane parts. Perhaps we can help you produce planes or components faster. Write us for specific suggestions.

AVIATION ENGINEERING
INCORPORATED

T. EDWARD MOODIE Exec. V. P. & Chief Engr.

1390 SLASHFIELD, S. E. ATLANTA GEORGIA

Also Fabricators of

PLASTIC BONDED PLYWOOD AIRCRAFT COMPONENTS

Ailerons · Flaps · Rudders · Elevators · Bomb Bay Doors · Tail Cone Fairings · Landing Gear Doors · Fins · Nacelle Fairings · Entrance Doors · Super-Structures · Stabilizers, Etc.

What's been learned the hard way

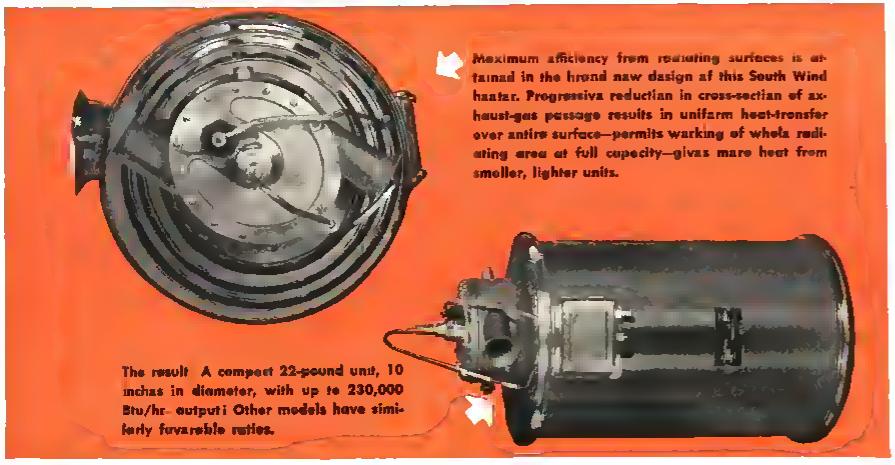
Makes South Wind Heaters Your Best Bet!

Important advances in heaters and accessory controls will help South Wind equipment heat more planes better this winter than ever before

HARNESSING a heater to the varying demands of speed, altitude, available space and special requirements calls for field experience as well as good fundamental design. And South Wind performance this year will benefit from years of such experience, gained in close cooperation with aviation engineers.

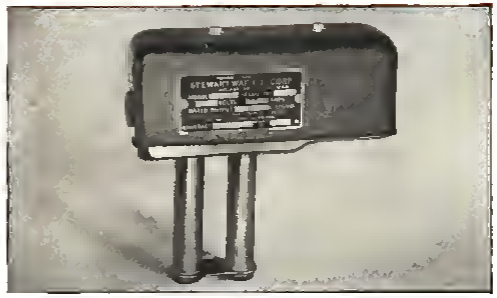
Last winter, for example, tens of thousands of South Wind heaters were in service under almost every condition . . . from sandy desert to Alaska's worst winter weather in years. And South Wind had a force of 40 men in the field with these heaters . . . observing performance and watching constantly for ways of bettering it.

It is against this practical background that South Wind has been able to pioneer such basic improvements as ram-air operation of combustion heaters, with its advantages in lightness and simplicity . . . the new South Wind "accelerating-flow" design with its greater heat-transfer efficiency . . . and important improvements in accessory controls, such as those illustrated on the opposite page, which lift South Wind performance to levels impossible a year ago.



Maximum efficiency from radiating surfaces is attained in the brand new design of this South Wind heater. Progressive reduction in cross-section of exhaust-gas passage results in uniform heat-transfer over entire surface—permits working of whole radiating area at full capacity—gives more heat from smaller, lighter units.

The result: A compact 22-pound unit, 10 inches in diameter, with up to 230,000 Btu/hr. output! Other models have similarly favorable ratios.



South Wind Thermo Switch combines automatic control of heater ignition and automatic overheat control—and embodies four outstanding advantages. 1. Control elements are *hermetically sealed*—impervious to dust, oil, moisture, or frost in duct air. 2. Has much quicker response—restores normal operation after overheat *4 or 5 times as fast* as former controls. 3. Mounts outside of heater and *holds entire control wiring system*—permits all control adjustments to be made without disturbing the heater. 4. High-altitude-relay type mechanism can be calibrated and adjusted with tools available in the field.



South Wind Duct Pressure Switch is a compact, light control with special damping mechanism preventing vibration from affecting its operation. Its sensitivity to very small pressure differentials meets a number of needs such as turning off ram-operated heaters *automatically* when plane lands—and holding heater out of operation until duct air pressure is sufficient for proper performance.

ARMY-NAVY

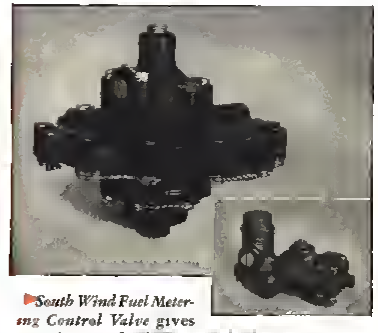
South Wind

REG. U. S. PAT. OFF.

HEATING EQUIPMENT

Heater Division, Stewart-Warner Corporation, Chicago
West Coast Office: Stewart-Warner Aircraft Heater Engineering and Service
1273 Westwood Blvd., West Los Angeles, California

Another Product of
STEWART WARNER



South Wind Fuel Metering Control Valve gives entirely new flexibility to injection-type heaters by modulating the rate of fuel injection according to demand. Without additional accessories, it can hold heater output to *a predetermined curve* for varying speeds and altitudes. *South Wind Altitude Compensator*, in conjunction with Fuel Metering Control valve, extends this automatic regulation to extreme ranges in altitude.

"Off we go, into the wild blue yonder..."*

Valiant, indeed, are those who have made this song their battle hymn. Who of us can honestly say that he would not turn back time, given the chance, to be able to join their select company—to consort with avenging eagles? It must be a heady business, but it's not for groundlings like most of us.

Time and the strict measure of a man's physical aptitude make most of us unfit for their company, so all that we can do is go with them in spirit.

No, not in spirit alone, for we can and do go with them directly in proportion to the War Bonds we buy.

Then too, many like us, producing equipment for their use, have a hand in their welfare—the ability and determination to build something better so that they will be better equipped to triumphantly fulfill their missions.

Champion Spark Plugs are but one small, vital piece of equipment produced for the air forces. But vital they are, and so into them we pour all the skill of our thirty odd years in the spark plug business exclusively, plus that extra zeal for Victory which motivates all of us.

* *By special permission of Carl Fischer, Inc., copyright owner of "The Army Air Corps," Robert Crawford, Author and Composer*



CHAMPION SPARK PLUGS

BACK THE ATTACK—WITH WAR BONDS



Out of Great Emergencies . . . New Leaders Arise

AMONG PEACE MEN, always, new leaders arise to meet the challenge of great emergencies. These are the men who deny the "don'ts" and the "can'ts" of conservative years and who dare the impossible.

There were several such "impossibilities" in the aluminum industry, before Pearl Harbor. It was "impossible" that America's war needs could ever exceed what was then considered a huge national production capacity . . . or that imports of foreign bauxite could be stopped . . . or that our bauxite could be turned into purest aluminum.

But far back in 1940, a single company challenged all three of those "impossibilities." Reynolds, then the world's largest aluminum foil producer, built a huge new plant in Alabama . . . began mining domestic ore . . . and deliberately prepared to process low-grade bauxite. Today this is the only plant in the U. S. where bauxite comes in at one end, *and aluminum sheet rolls out the other!*

As war came, the huge rewards of this pioneering became apparent even to the most skeptical. But Reynolds kept on breaking precedents. From earth to aluminum sheet was one step. They dared the next step—earth to sheet *to finished aircraft parts*. Now Reynolds feeds endless streams of airplane parts to assembly lines throughout America!

And there is even more to this story than the quantity production of aluminum ingot, aluminum sheet and finished aircraft parts. The wings of our victorious armadas demand quality as well as quantity . . . they must be made ever lighter and stronger. Reynolds engineers are preparing to announce new miracles of metallurgy. Further "impossibilities" will be conquered . . . in Reynolds' steady progress toward Leadership in Aluminum.

REYNOLDS ALUMINUM

OUT OF THE GROUND INTO THE SKY

REYNOLDS METALS COMPANY
GENERAL OFFICES RICHMOND, VA.
38 PLANTS IN 13 STATES

AMERICA'S NEW SOURCE OF ALUMINUM

INCREASED PRODUCTION!
MORE ACCURATE WORK . . SUPER-SMOOTH FINISH

with the **SUNNEN "MA"**
PRECISION HONING MACHINE



On internal cylindrical surfaces from .185" to 2.625" in diameter, the Sunnen Precision Honing Machine will handle production jobs to within .0001" limits — and produce a super-smooth finish of 2 to 3 micro-inches. In actual practice, jobs have often been held to .000025".

And, in addition, production has been increased — in some instances, up to 500% — with fewer rejects and absolute interchangeability of parts.

Skilled labor is unnecessary—new workers can be trained in a few hours. Low in cost—economical to operate. No jigs or fixtures necessary. Can be set up in less than one minute. Guaranteed accuracy—super-smooth finish.

A Sunnen engineer will gladly call and show you what the Precision Honing Machine can do on your job—in your plant. Or, if you prefer, write for free bulletin giving complete information.

SUNNEN PRODUCTS CO., 7942 Manchester Avenue, St. Louis, Mo.
Canadian Factory: Chatham, Ontario

SUNNEN

On Jobs Like These!



Carburetor Idler Valve Jet Hole is honed after reaming for smooth act on.

Roller Bearing Outer Race. Finish improved from 12 micro-inches to 2 micro-inches.

Bearing. A very small part. 2 micro-inch finish necessary

Carburetor Idler Pump. Smooth, straight line finish in blind hole prevents piston leakage

Ceramic Insulator. Honing used to eliminate roughness inside ceramic tube

Hydraulic Metering Valve Stem. Hole 1.54" in drum after reamed, heat treated and then honed. Honing 3 times as fast as previous method

Aircraft Instrument Panel Cam. Tool Wire Bushing Hole 1.87" diameter—held to .0002" stock removal .001", sixty per hour.

Header Die. Life of header die increased 3 to 9 times over lapping. Knocked pin breakage practically eliminated

Aircraft Hydraulic Brake Cyl inder. Honing 3 times faster than lapping—and gave a straighter hole.

Aircraft Piston Pin. Sunnen honing is twice as fast and gives a cleaner, better looking pin.

Cast Iron Valve Stem Guide. 1/16 mm thickness removed —220 pieces per hour. Better finish and straighter hole.

Stainless Steel Lead Compensator Valve Seat. Hole is honed to .0002" limit

Shell Loading Die

Idle Valve Guide. Honing after grinding holds a .0002" limit necessary for accurate idling

Aircraft Valve Tappet Relief. Honed after grinding to give 100% bearing surface.

Hydraulic Control Bushing. Honing gives straight round hole after rough reaming

Aircraft Carburetor Operating Valve Sleeve. Sunnen honing eliminates distortion from assembling operation.

Automobile Distributor Shaft Gears. Taper removed at a rate of 80-90 per hour

Compressor Yoke. Alignment maintained and better finish produced.

Mild Steel Clevis. Honing corrected errors of previous operations and maintained true alignment of two holes

New BOOK OF REVELATIONS



On *advanced* Fastening Technique

This booklet will make any assembly engineer happy. Its 24 pages are filled with over 50 new assembly devices and methods that save critical material, reduce weight, conquer vibration loosening, shorten assembly time and lower net costs. The new fastenings illustrated in this book are already speeding up assembly of planes and other war equipment. • This literature will not only help you right now, but will also serve as a handbook in planning assembly short cuts for your post-war products. SPEED NUTS specified for the assembly of these products of the future will pay big dividends.

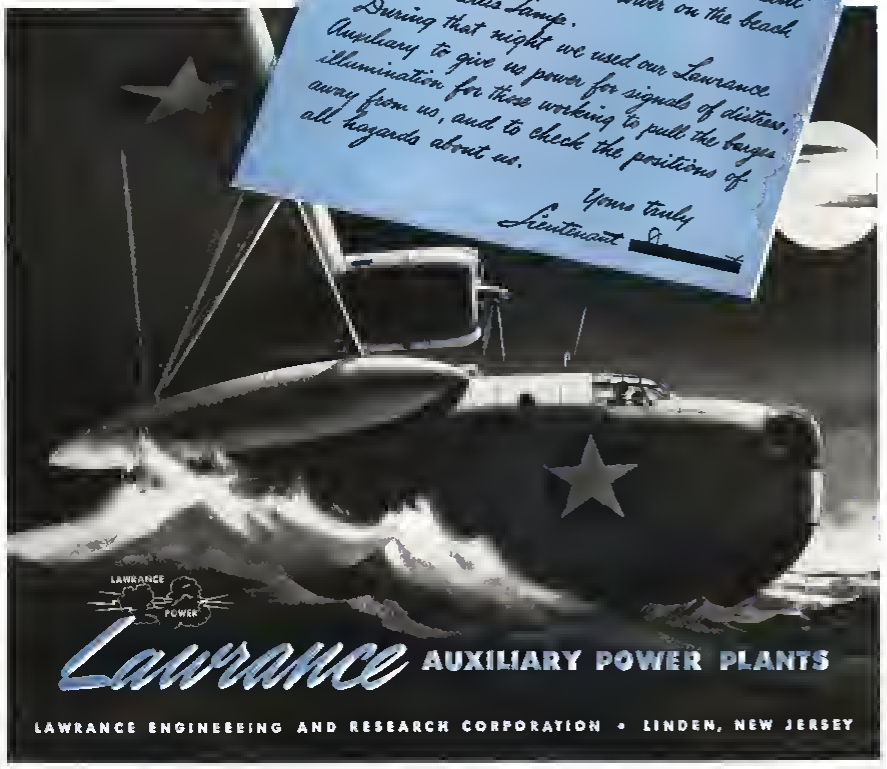
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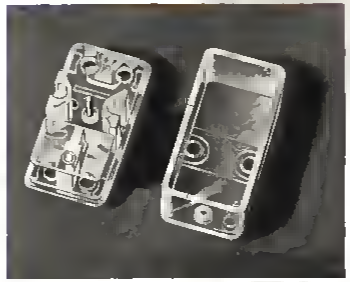
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These light-weight, compact Auxiliaries
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Ease of fabrication ranks high on the list of outstanding Styron characteristics. By using this thermoplastic injection molding material, one cavity for each part is sufficient for producing the housing illustrated above. Faster molding cycles are also possible. Thus, through Styron, the cost of fabricating equipment is reduced, and production volume increased.

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★ . . . . . *Especially valuable on jobs like the one illustrated.*

THE transmission gear blanks, shown above, are ground on a Blanchard No. 18 Surface Grinder. They are held on the 30" Blanchard magnetic chuck. The blanks are 3½ inches in diameter and are made of forged alloy steel. .020 inches of stock is removed from each side to limits of .0005" for parallelism. Blanchard Grinding produces accurate blanks that stack and cut well—and produces them at a rate of 250 (500 surfaces) per hour.

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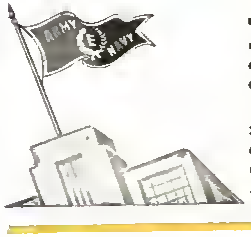
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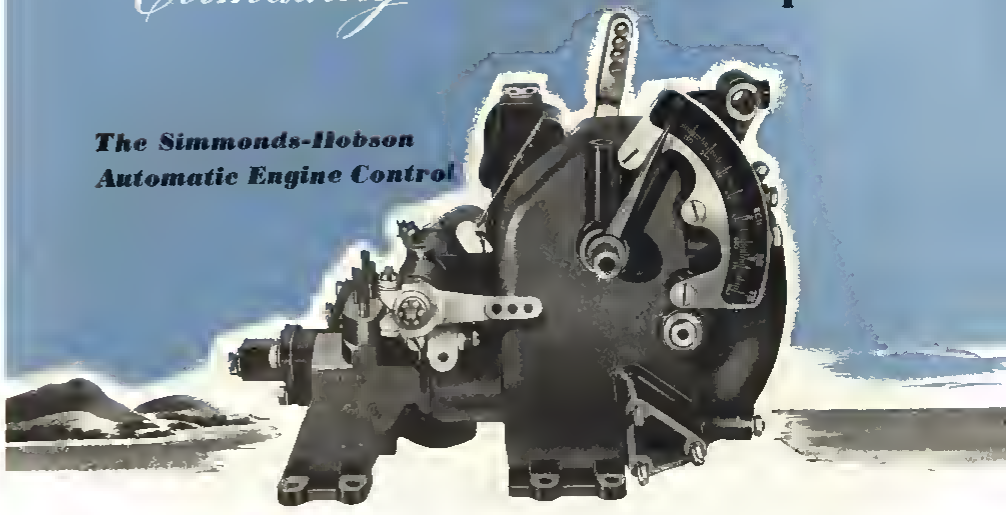
Formica control pulleys are the result of good engineering and progressive production methods.

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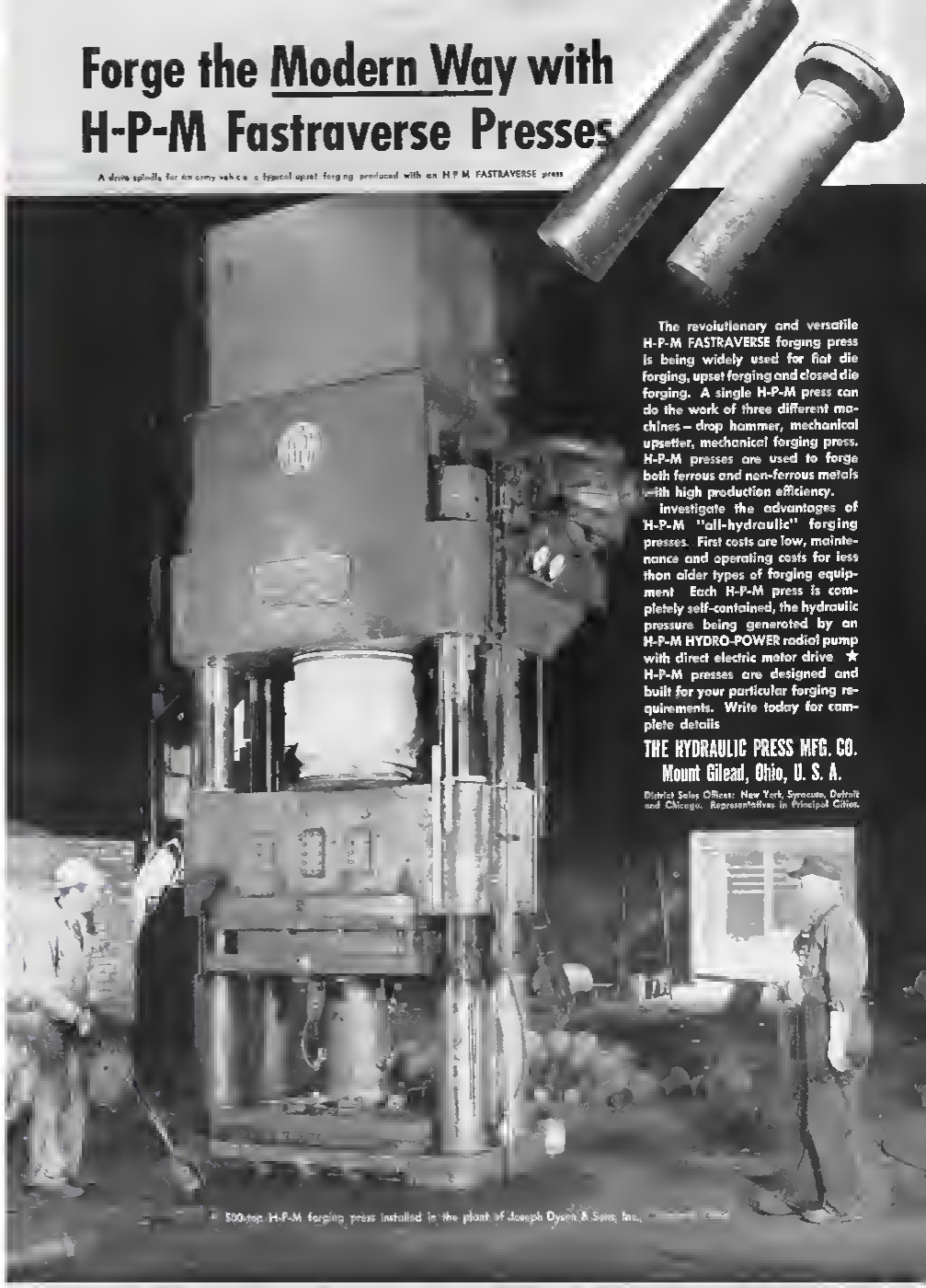
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A drive spindle for an army vehicle, a typical upset forging produced with an H-P-M FASTRAVERSE press



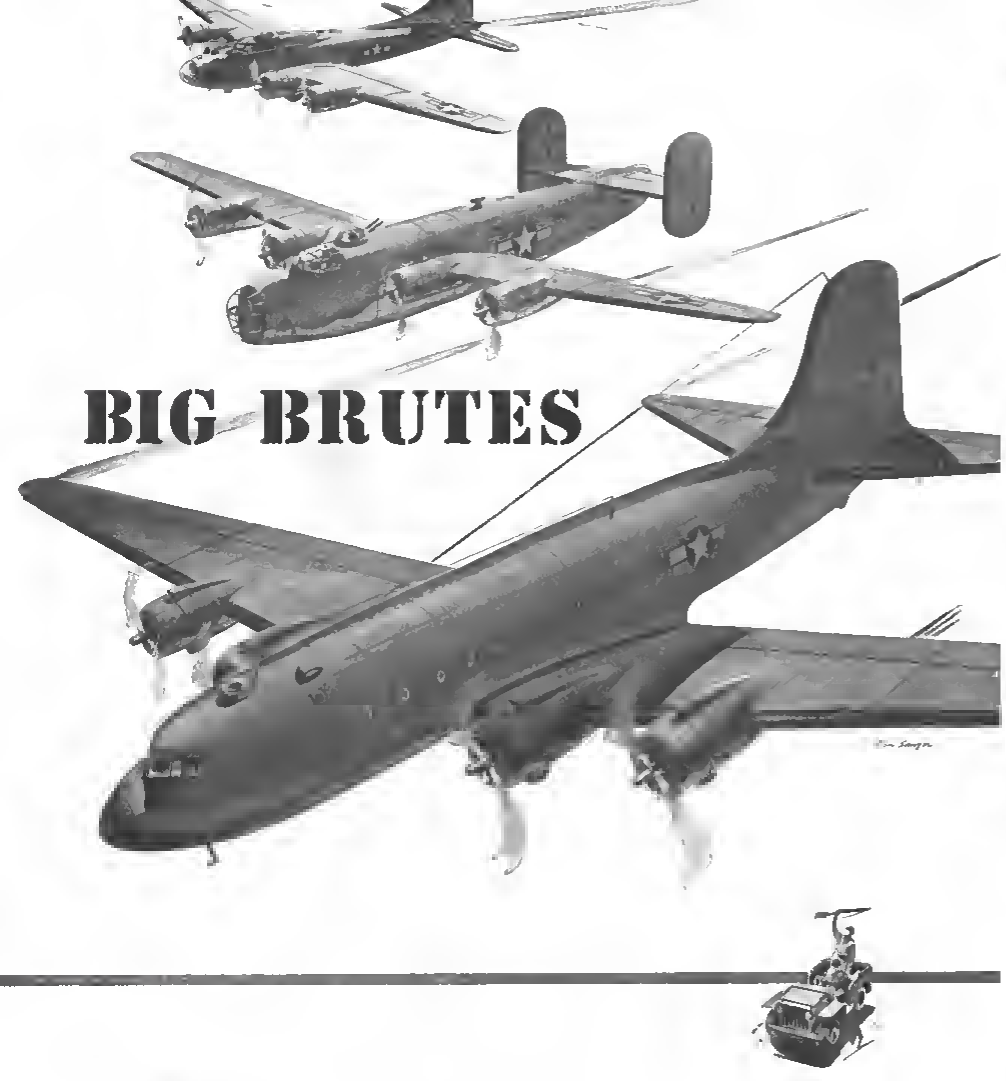
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BIG BRUTES

Douglas Builds All Three

When United Nations air strategy called for concentration on heavy bombers and transports, only Douglas was chosen to produce all three current 4-engine types. Douglas' own C-54 Skymaster Combat Transport (bottom), the B-24 Liberator Bomber and the Flying Fortress. Douglas production of "big brutes" has been on schedule or ahead of schedule, in addition to fabulous output of more other types of aircraft than any other manufacturer.

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"AN" AIRCRAFT Turnbuckles
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RELIABLE CREATES NEW METHODS to Eliminate Production Bottlenecks

The Reliable Electric Company of Chicago after many months of close cooperation with the Army Air Force Production Engineering Department and Aircraft Laboratory, and endless experiments, have effected savings of 46% in critical material and 100% in critical machine time in the production of turnbuckle barrels, and 91% in critical material and 96% critical machine time in the production of turnbuckle forks, to provide prompt delivery of Aircraft Turnbuckles

Value of Experiments

As an indication of the value of these developments, the saving on 100,000 AN150-32L Turnbuckles, which is a moderate quantity of an average size, is 60,800 lbs of molybdenum steel and 9,100 lbs of brass

The bottleneck in skilled operators and critical machine tools—largely on turret lathes and multiple spindle automatic screw machines—is relieved to the extent of 22,725 hours on this quantity. This time can be devoted to the production of other critical AN parts by placing fork and barrel orders with Reliable

The Reliable Electric Company normally devotes its entire capacity and laboratory to the development and manufacture of telephone and power line equipment. At present this company is applying its modern facilities in many fields with similar results to those mentioned above from which interesting future communication and power equipment developments can be expected

A N 150 Turnbuckle Assembly
A N Part No
AN150-16S
AN150-16L
AN150-32S
AN150-32L
AN150-46S
AN150-46L

A N 155 Turnbuckle Barrel
A N Part No.
AN155-8S
AN155-16S
AN155-16L
AN155-32S
AN155-32L
AN155-46S
AN155-46L
AN155-61L
AN155-97L

A N 161 Turnbuckle Fork
U. S. ARMY AIR FORCE Part No
Air Force X43B2342-16LS
Air Force X43B2342-16RS
Air Force X43B2342-16LL
Air Force X43B2342-16RL
Air Force X43B2342-32LS
Air Force X43B2342-32RS
Air Force X43B2342-32LL
Air Force X43B2342-32RL
Air Force X43B2342-46LS
Air Force X43B2342-46RS
Air Force X43B2342-46LL
Air Force X43B2342-46RL
A N Part No.
'AN161-16LS
''AN161-16RS
AN161-16LL
AN161-16RL
AN161-32LS
AN161-32RS
AN161-32LL
AN161-32RL
AN161-46LS
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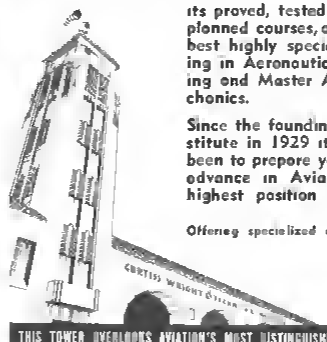
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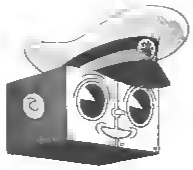
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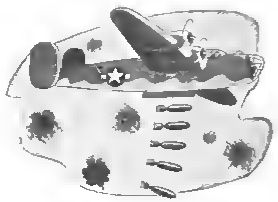


Song of Elmer . . . the pilot who never gets tired

He holds no place in the Officer's Mess
for he does not sleep or eat,
He's the Quietest Birdman ever took
his place in a cockpit seat—
He joins no laughter, nor shoots the breeze,
nor whistles, nor hums, nor sings,
But he's flown more planes than any man
who ever wore pilot's wings
has Elmer!



He's an old old hand . . . old hands go
in a young man's game today,
For he circled the globe in Thirty three
with Post in the Winnie Mae—
He's an Army man, he's a Navy man,
and he flies with the R A F,
And the Yankees say, and the British say
of pilots, he's the best . . .
is Elmer!



Often when bombers have levelled off
for the last tense bombing runs,
And the bomb-bay doors are opened wide,
and the gunners man the guns,
When the flak comes up as the bombs
go down, and the target zone is clear,
Then who is the pilot who holds the course
set by the bombardier . . . ?
It's Elmer!



He can hold a plane on a chosen course
while the crewmen rest or sleep,
He can level off for a landing glide,
or bank her sharp and steep—
He can spiral up, he can spiral down,
or hold her level and true—
His hydraulic muscles never tire
the way human muscles do . . .
. . . not Elmer's!



And so bombing, transport and cargo
planes, take Elmer on every flight
To spare the pilot and rest the crew
for emergency, storm, or fight—
He needs no rest, for he never gets tired,
being only a cold machine,
Just wheels and wires and gears and cogs,
with brackets and stuff between . . .
. . . is Elmer!



He wears no medals, he holds no rank
Why should he? He cannot feel
The courage that flares in time of need
for he's only alloy and steel!
So when *nerve* is needed the bombardier,
the pilots, the gunners, too
The navigator, and all the rest,
are the boys who pull her through
NOT Elmer!

SPERRY
GYROSCOPE COMPANY, INC.
is proud to be manufacturing the famous Sperry Gyropilot for the Armed Forces of the United Nations.
Brooklyn, N. Y.
Division of Sperry Corporation

a Reprints of this poem—suitable for framing, with signature removed—may be obtained without charge by writing the Sperry Gyroscope Company.



Eimac gets another "E"

Mass production of a device that has always been hand made in a laboratory is an achievement in itself. But when the whole nation gives pause to *recognize outstanding excellence in this mass production* the achievement becomes all the more striking.

Such honors have been bestowed upon the Eimac organizations not once but twice. First to the San Bruno, California, plant (September 1942) and second, less than a year later, to a plant in Salt Lake City, Utah, that is little more than one year old.

Where does the credit go? . . . to the men and women at the Salt Lake City plant now for their recent triumph . . . and to the men and women of both plants always for their collective cooperation and hard work.

Follow the leaders to Eimac TUBES

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Plants Located at San Bruno Calif., Salt Lake City Utah
Export Agents FRAZAR & HANSEN, 301 Clay Street, San Francisco, California, U. S. A.



Engineered for the Job!

One reason why so many aircraft manufacturers put their landing gear problems up to Bendix is the Bendix policy of "engineering for the job." Whether the assignment is a tail strut for a trainer, or massive main struts for the heaviest bomber, Bendix designers study carefully all requirements of the plane and develop whatever adaptations of Bendix* Landing Gear are necessary to insure efficient performance.

The basic advantages of Bendix* Pneudraulic Shock Struts, Wheels, Brakes and Hydraulic Master Cylinders have been proved under all conditions of service, from the arctic to the equator and on all types of terrain, from frozen tundras to steaming jungle mud.

Why not benefit from Bendix diversified experience and practical methods of operation when you plan the landing gear for your planes?

BENDIX*
LANDING GEAR

Bendix-Pneudraulic* Shock Struts, Bendix Airplane Wheels, Airplane Brakes, Hydraulic Master Cylinders, Pilot Seals and Power Brake Valves are important members of "The Invisible Crew" of precision equipment which Bendix Plants from coast to coast are speeding to world battle fronts

*Trademark of Bendix Aviation Corporation

THE INVISIBLE CREW
Precision Equipment by Bendix
AVIATION CORPORATION

BENDIX PRODUCTS DIVISION
Bendix Aviation Corporation · South Bend, Indiana

Free Enterprise

WE MUST ACT TO PRESERVE IT!

☆

LIKE a leaf floating downstream, we are being carried along toward a new and uncharted economy. What this new economy will be like will depend, to no small extent, upon what industry does or fails to do during the coming months. Time is short; in fact, we may suddenly find ourselves standing on the threshold of a peace economy with our war boots still on our feet.

While bending every effort to win the war, we cannot afford to be caught unprepared for the peace. As Prime Minister Churchill said at Harvard, we are "bound, so far as life and strength allow and without prejudice to our dominating military task, to look ahead to those days which will surely come, when we shall have finally beaten down Satan under our feet and find ourselves with other great Allies at once the masters and the servants of the future." Unless we do look ahead, there is danger that we may become neither the masters nor the servants, but merely the victims, of the future.

The war has quickened our ailing economy and opened our eyes again to the possibilities of peace-time plenty. But it has also brought great dislocations of labor and capital, it has led to abnormal patterns in prices and income distribution, and it has created inflationary pressures with enormous potential powers to injure or to help us in the transition from war to peace.

The pattern of life in postwar America will be just what we make it. All of us will have a hand in shaping that pattern, but business men will have a special responsibility in the reconstruction. As employers of labor and capital and as enterprisers assuming the risks of new ventures, they will have to plan and carry out the conversion from war work to full peace-time production. Because of their key role, business men have a special opportunity to discover, and to help others to understand, the conditions which are necessary if they are to do their job satisfactorily.

This is a narrow view of postwar problems but it is a central view, because no one condition is more vital to the health of the world than a high level of production and employment in the United States. We cannot hope to lead the world out of economic chaos if we fail to put our own house in order. If we fail to adjust our domestic economy, we may destroy Adolf Hitler, but we will not destroy the germ that breeds "Hitlers." If we do not maintain the production necessary for supporting a large volume of imports and exports, then the plans for international monetary stabilization, for good relations with our neighbors, for rehabilitation of stricken countries, and for strengthening the democratic bulwarks against dictatorship are all likely to come to grief. We must demonstrate our capacity for world leadership, or be content to follow the leadership of others.

The prospects for achieving a sound and vigorous economy in the United States are not so good as to warrant complacency on the part of men genuinely interested in free enterprise and the political freedoms incident to it. We have yet to find means to utilize our vast and abundant resources for the good of all. We have yet to learn how to keep men from the terrible experience of unemployment and the fear of want which makes them willing to sacrifice freedom and opportunity for almost any promise of security. We have yet to reconcile the conflicting interests of labor, agriculture, and business so that they can work together effectively. We have yet to learn how to check the fever of inflation and cure the palsy of depression.

When we were attacked at Pearl Harbor, we realized our physical peril immediately and united in a tremendous common effort against the enemy. The onset of economic perils is less obvious. No bombs will signal the deterioration of the private enterprise system, the extension of regimentation, the further control of busi-

ness by government, and the concentration of political power in less and less responsible hands. If these things should befall us, they will come insidiously while we are preoccupied with self interests and oriented by popular misconceptions. If the freedoms of the individual shrivel as the state grows in power, it will be because the individual is too indifferent or complacent to concern himself seriously with economic problems. If our people are misled by false prophets and demagogues, it will be because business men did not understand economics, because scholars were too ignorant of practical affairs, and because we failed to produce economic statesmen of sufficient stature for the task in hand.

Thinking is hard work. Thinking about things outside our personal experience, about economic processes that are broader and in some fundamental respects different from buying and selling or running a business—is strenuous mental labor. Thinking straight about problems that are beyond our personal and immediate status and our pocketbooks, thinking about problems that involve nation-wide production, nation-wide employment and nation-wide buying power—in other words the operation of our entire economic system—involves real self discipline. Yet there is no other way to safeguard our freedoms. We cannot rely on trial and error tinkering takes too long, social experiments which turn out wrong can be undone only at great cost—if at all. If we proceed blindly, we shall flounder into an economic and political morass from which we cannot escape.

We floundered badly all through the Thirties, until the war lifted us temporarily to higher ground. When the war boom is over, we shall be back floundering worse than ever unless we find a solid road along which to proceed.

America has grown rich and strong under a system of political and economic freedom. Opportunity and the necessity of self reliance have brought forth great accomplishments. The hope of profit and the spur of competition have urged men on to find new and better products, new and better methods, and to risk their savings in pioneer investment. Never has a country achieved so high a standard of living and afforded so large an opportunity for the individual man and woman. It is not surprising that some distinguished business leaders, looking back over their own experience, tell us that everything will be all right if only there is "less government in business."

I wish the solution were as simple as that. However this is only part of the answer. It is becoming increasingly clear that industrial capitalism as we know it contains within itself certain fundamental weaknesses which can lead to its destruction if they are not counteracted. No democracy can survive when twenty to thirty per cent of its workers cannot get jobs. That happened here in the Thirties. For years on end, despite fumbling efforts at recovery one out of every five workers was denied a chance to earn a living in private business. We shall never again have such mass unemployment as occurred in the bottom of the Depression, because the government will take it upon itself to create jobs if business cannot offer them. Whenever that happens, however, the area of private enterprise will be reduced and that of government will be expanded—and the concentration of political power will be increased. This is the challenge we business men face today, and ours is the first opportunity at finding the solution.

The crux of our economic problem is unemployment. Unless there are jobs for ninety to ninety five per cent of those who are able and willing to work, there will be widespread fear and lack of opportunity, which will drive labor unions, agricultural groups, and business interests to take self protective measures. Such measures are certain to restrict production, stifle progress and imperil our democratic way of life. Not all our problems will automatically be solved if we learn how to avoid mass unemployment, but they will at least then have a good chance of solution.

And so American businessmen face a great responsibility! We will have to find the answer to a great many momentous questions. We will have to delve into problems that cannot be solved by precedent.

Looking backward to these times, future historians are likely to say that here we Americans stood at the crossroads and, consciously or not, made our choice between a system of private enterprise and personal freedom and a system of collectivism and regimentation.

It is particularly appropriate, therefore, as the problems of our time take shape and as events rearrange their order and importance to appraise the steps we are taking and point the way we are going. It is my plan to present such analyses from time to time to the one-and-a-half million readers of McGraw-Hill publications.

James H. McGraw, Jr.

President, McGraw-Hill Publishing Company, Inc.

Manpower for *Make*power

As we bask in the warm flush of major military victories, a home front scourge has struck in the West and is sweeping eastward, threatening to blight the largest crop of military airplanes in the world's history. The peril that pursues the aircraft industry is a manpower shortage so acute that it threatens not only the plane production program but also the rapid and efficient termination of the war. Already the fighting forces have been deprived of equipment for which materials were available but labor was not. And there is grave danger that this will be repeated as the industry strains to achieve the last 20 percent of its production goals.

Our remarkable military successes so far have been the result of careful pre-invasion preparation. An important part of this preparation has been the effective aerial bombardment of objectives before the surface forces moved in. Our air strategists are proving their belief that adequate pre-invasion bombing cuts the invasion force required in half and reduces expected casualties from 50 to less than 20 percent of the original force (see chart, page 17 August AVIATION).

But in spite of this overwhelming evidence that airplanes in action *now* will save the need of foot soldiers, key personnel is still being taken from important places in the design and production of aircraft and sent out to camps to learn saluting and the *Manual of Arms*. The aircraft industry suffers most severely because it is a young man's business. Between 25 and 50 percent of the engineering personnel of the industry are in the 18 to 25 year old range and many of these men are unmarried.

Numerically the military severances are not the largest part of the losses of personnel in the aircraft industry. Many women workers are resigning because they feel that they can't simultaneously hold their jobs and operate their homes properly in the face of the increasing handicaps to civilian life in wartime. But it is the selective service losses that hit the airplane makers hardest because they involve key personnel in research, engineering, and production supervision. And these key men are rapidly becoming more and more difficult to replace.

Corrective steps have been taken by numerous government agencies, but so many offices are involved that the procedure appears hopelessly complex. The air is full of talk about redistribution of production and forced subcontracting. It is quite late in this war to start moving production projects around. Such movements require long months of time and tooling. It is even more impractical to talk about forcing subcontracting. The most successful subcontracting has been found to be the result of long periods of close relationship and training of the subcontractor by the parent manufacturer. In almost every example of this relationship some degree of production loss is experienced during the indoctrination period. And it only takes one unsuccessful subcontractor to tie up the home plant production line in costly knots.

The "Buffalo Plan", with its controlled referral hiring involving the necessity for certification by the United States Employment Service, has not solved the manpower problems of the aviation industry where it has been tried. A nation wide extension of this plan would only extend its ineffectiveness.

No sound solution will be found until several specific steps are taken. First a major decision must be made as to the proportion of airplanes and foot soldiers most effective in the war effort (see article Which Will We Get—Men or Planes? page 110). Then the number and complexity of relationship of the government agencies involved in the manpower problem must be reduced. Selective Service regulations must be amended to retain key personnel and, in some cases, to withdraw from military training certain key men already inducted. Home front wartime living problems must be simplified to enable workers to spend more time at their work and to waste less time trying to solve the unnecessarily complex problems of acquiring the necessities of life. Finally, thorough studies such as those already put under way by our AWPC's, must be made of the other underlying reasons for labor turnover and corrective measures must be applied at once.

Leslie E. Neville

EDITOR







Which Will We Get— Men And/Or Planes?



By JOHN FOSTER, Jr.
Associate Editor "Aviation"

Curse of divided responsibility and authority puts two strikes on new West Coast War Manpower Program—move to extend temporary plan eastward revives danger of "too little, too late."

WILL THE GOVERNMENT lock the mid-west and east coast manpower barn after the horse has been stolen—as has happened on the west coast?

There is overwhelming evidence at this writing that such will be the case. In fact, critical labor shortages have already developed in some eastern areas, with other important aircraft producing centers inexorably headed for the same situation. It threatens to be vastly more serious than the materials shortages which were the industry's last big headache, for new facilities have brought raw materials production to required levels. The Controlled Materials Plan, with certain industry suggested modifications (page 114 Apr. AVIATION, is working satisfactorily so that, with minor exceptions in certain alloy steels, production goals will not be impaired.

Despite the fact that the West Coast War Manpower Program (put into effect the 15th of last month) had the benefit of "Elder Statesman" Bernard Baruch's study and influence, it is admittedly a stop-gap arrangement—an experiment that is given little chance to succeed.

Nevertheless, mid-west and eastern airframe and engine manufacturers are faced with having to work under an extension of the program even though it may be modified and certain features deleted before it is applied eastward from the Mississippi.

The West Coast program is a stop gap measure for one inescapable reason: *It does not get down to the fundamental cause of the manpower shortage.*

Today the industry has approximately 1,700,000 employees; to meet production schedules already authorized it will need at least 2,200,000. On the basis of past labor turnover records, it will be necessary to hire more than 1,500,000 new workers to achieve the net increase of 500,000. The number would be vastly higher except for the fact that the industry confidently expects to achieve a 40 percent increase in manpower utilization—in other words, that it will reduce by an additional two-fifths the number of man-hours necessary to build planes. On top of the magnificent man-hour reductions already accomplished, such a cut will be no mean feat, but there is every reason to believe it can be done with new tools and procedures now becoming available.

It can be done even with the qualification levels of workers now available. This should by no means be considered derogatory to these workers; it is simply the unavoidable fact that people—mostly women—going to work in aircraft plants today just don't have the "factory sense," an essential inherent or acquired adaptability of those who went in, say, a year ago. Today's workers no doubt are just as patriotic as those who took aircraft jobs a year ago, but patriotism alone can't produce work that meets aircraft tolerance requirements.

While the West Coast Program appears to recognize the fact that the labor supply barrel is literally pumped dry, it is felt to be too complicated and, like many other vital parts of the nation's war program, cursed with divided responsibility and authority.

According to the official outline of the program, "direction and over-all coordination" comes under Paul V. McNutt's War Manpower Commission, to which is "assigned the responsibility for directing and coordinating those phases of the West Coast Manpower Program concerned with the supply and distribution of labor." WMC, it will be recalled, was set up by Presidential order which, together with its need to go to Congress for funds, definitely limits its authority.

"Determination of production urgencies and manpower priorities," however, is the responsibility of the War Production Board, which is "concerned with the adjustment of production programs to meet the available labor supply, as reported and developed by the War Manpower Commission."

These two agencies shall establish, in such areas as they may deem necessary, what the Program calls "Area Production Urgency Committees," comprised of "one responsible representative of each of the following":

War Production Board (Chairman)
War Manpower Commission
War Department
Navy Department
Maritime Commission
War Food Administration
Aircraft Resources Control Office
Office of Defense Transportation (when transportation problems are involved)

Such other agencies as the Committee may, from time to time, invite to assist it.

Then, "when adjustments in the military programs become necessary, due to shortage of labor, after full effort to increase the available supply either the full Committee or a sub committee composed of those members representing the military programs and War Manpower Commission under the chairmanship of the representative of the War Production Board, will submit their recommendations with respect to such adjustments to the Chairman of the Production Executive Committee of the War Production Board for action."

Meanwhile, actual manpower priorities and allocations are to be determined by Area Manpower Priorities Committees, composed of the same representatives (or other men from the same agencies) as the Area Production Urgency Committees, plus representatives of Selective Service and the Committee for Congested Production Areas. The chairman, appointed by WMC, shall wherever possible, be "an outstanding citizen not affiliated with any of the above agencies nor identified with a dominant group interest" who has been recommended by the Area War Manpower Commission Management Labor Committee.

Thus it is evident that the Army and Navy, purchasers of all aircraft and practically all output of every other essential industry, have but a minor voice in allocation of manpower and facilities. The balance of power is held by agencies which, in the past, have shown decided differences of opinion.

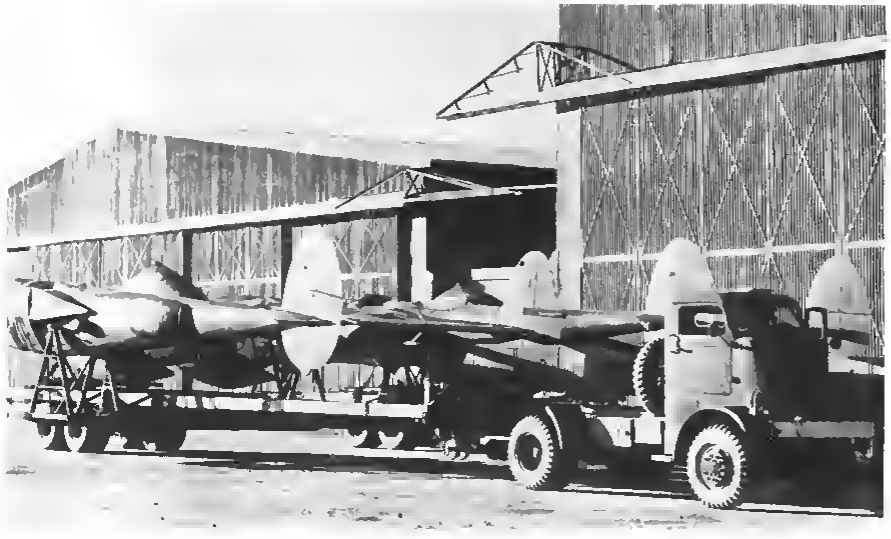
In addition to the complexity of the administrative bodies, the means for operating the program are believed to be inadequate to the task ahead. One of the four operating points for "balancing production and manpower requirements," for example, reads:

"Where it will be advantageous to the war program, war production will be removed from the West Coast by the curtailment and redistribution of production and by forcing subcontracting, with due regard for differences in efficiency of production."

The greatest reason for removing production from the West Coast arose Sunday morning, Dec. 7, 1941. Yet not one plant was moved then or immediately after, for the simple reason that time was too precious. But suppose, under the present program, it was decided to move production of one plant to one of the mid-western plants built since Pearl Harbor and now in production. Tools would have to be moved, workers—even though skilled—would have to be trained on the new plane. Production experts estimate that six months' output at the very least would be lost, and at today's production rates, six months represents a cost the armed forces simply cannot afford. Time is as precious now as it was on Dec. 7, 1941.

Granting that the case just cited is extreme, and that only parts or component production is moved from the West Coast and labor thus made available there, will the problem be solved? There is considerable well founded skepticism regarding chances for success, largely because it brings into operation controlled referral hiring—developed from the so called Buffalo plan—whereby all

(*Turn to page* 353)



Huge trailers bring new aircraft from unshipping points to bases where they are re-assembled.

Lockheed Overseas Keeps 'Em Flying

By **REAGAN C. STUNKEL,** *Gen'l Service Mgr., Lockheed and Vega*

Combat flying is tough, but repairing and rebuilding combat planes in war zones is even tougher. The author describes the key method of organizing AAF bases and repair units.

MAINTENANCE of aircraft and aircraft components has long been considered a secondary adjunct to the operation of aircraft. Never, until recently, has the art of maintaining aviation products assumed its place among the skills allied with the manufacture and operation of aircraft. But today the art of aircraft maintenance has been forced by necessity into its position of first importance.

It is unfortunate that we have had to learn the hard way the importance of conceding to the job of maintenance engineering its place among the aviation arts. Some prewar foresight would have paid rich dividends in this war of wars.

During peacetime, back in the days of the beginning of the development of our airlines, the maintenance of aircraft was subordinate to almost every other airline function. Airline executives soon found that if their organizations were to continue to exist and if schedules were to be met, the maintenance of their equipment must of a necessity assume an important place in the operating picture. This trend has been evidenced more and more by the advancement of men from positions as maintenance superintendents to positions of vice-presidents and as officers on the planning boards of the operating companies. Strong recognition of the problem became most apparent in the year before we entered the war. In the keen competition which will follow the war, there is little doubt that the role of aircraft maintenance will become an increasingly important phase of commercial operations.

But now we are in a war. The same rules that applied on a small scale to the prewar airline picture now apply on a gigantic scale to the business of fighting. Maintenance of our aircraft and equipment must receive the first priority if our AAF is to retain its power to punch.

The reasons are simple. First, there is little doubt as to the necessity for the concentrated use of thousands of aircraft in every war theater.

Second, our modern aircraft and its equipment comprise the most complex machine ever devised by man. The complicated gadgets must all function properly or the machine is useless. Third, as the numbers of aircraft increase, the numbers of men technically skilled to overhaul and repair the complex components must increase in direct proportion, and time is too short to permit the extensive training required. Fourth, our methods of maintenance must be revised rapidly to suit each new device and the requirements peculiar to each theater. And fifth, which sums up the whole problem, an airplane on the ground in England or Africa or any other front, is of no value to anyone.

But even if it should require 5,000 hr. of work to return it to the air, the reconditioned craft is more valuable than a new plane on the factory ramp.

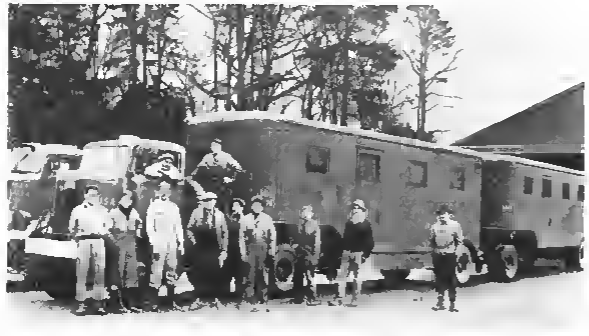
The new ship at the factory must be modified for the theater for which it is intended and must then be delivered. After arrival at the front, further modifications may be required before the plane can be placed in service. Long before that time, the damaged plane on the spot can be returned to service and the new plane could be used in some other theater where it may be more badly needed—provided the proper equipment and skilled men are there to do the job.*

As a matter of simple mathematics, the replacement of damaged aircraft with new aircraft without regard to repair is impractical and unsound. We would soon find our losses exceeding our production, a condition which would tend to weaken our position and lengthen the war, and one in which, of course, we must never find ourselves.

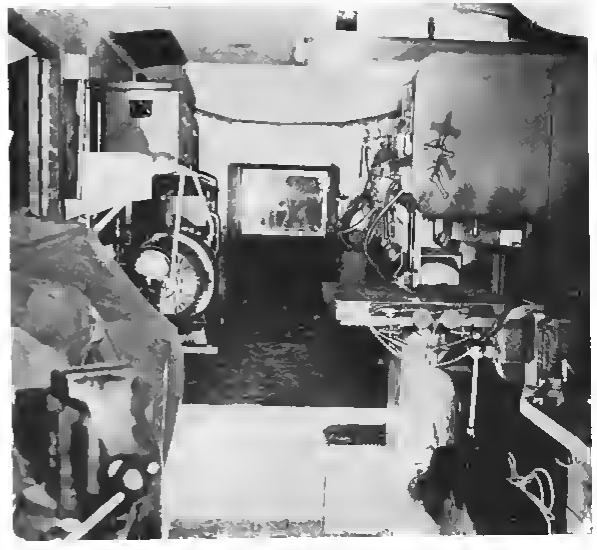
No set of maintenance rules can be devised which will apply to every theater. For example, activities in England assume the status of fixed-base operations of heavy bombardment aircraft, while in Africa and Sicily the war has moved constantly toward the heart of the enemy, with all types of aircraft being used. In Australia and the Solomons the distances are great and transportation is too difficult to permit pure base-type operation. Further, as the war progresses, our maintenance must be in a position to move up rapidly with fighter squadrons and bomber bases to new strategic positions.

In considering the problem, it is unnecessary to dwell on such operational service of the aircraft as changing plugs, filling shock struts, and the multitude of regular service operations necessary to keep an airplane in flying trim. This job is very capably handled by the

(*Turn to page 298*)



Lockheed uses many mobile repair units in situations where work must be done quickly and efficiently in places far removed from a base.



Complete, compact, and self-contained, this mobile machine shop contains Doall saw, welding equipment, compressor, and gasoline-electric power plant. Under cover is 9-in. lathe.



Bombers or fighters, they all are handled by Lockheed Overseas bases. Here are P-39, B-17, B-24 and P-38 all being modified or repaired under same roof.

* Also see article Yank Modification Center Rises in England page 235 May AVIATION.

You Can't Write Profits in Red Ink

By RAYMOND L. HOADLEY,
Financial Editor, 'Aviation'

Attempts by political and politico-editorial "experts" to make "war profiteers" of aircraft manufacturers are popping—but not where the "experts" are looking. Why this tergntry-oe-o-toogent doesn't "add up" is demonstroted by our financiol onolyst, who gives the true pictere of the industry's position.

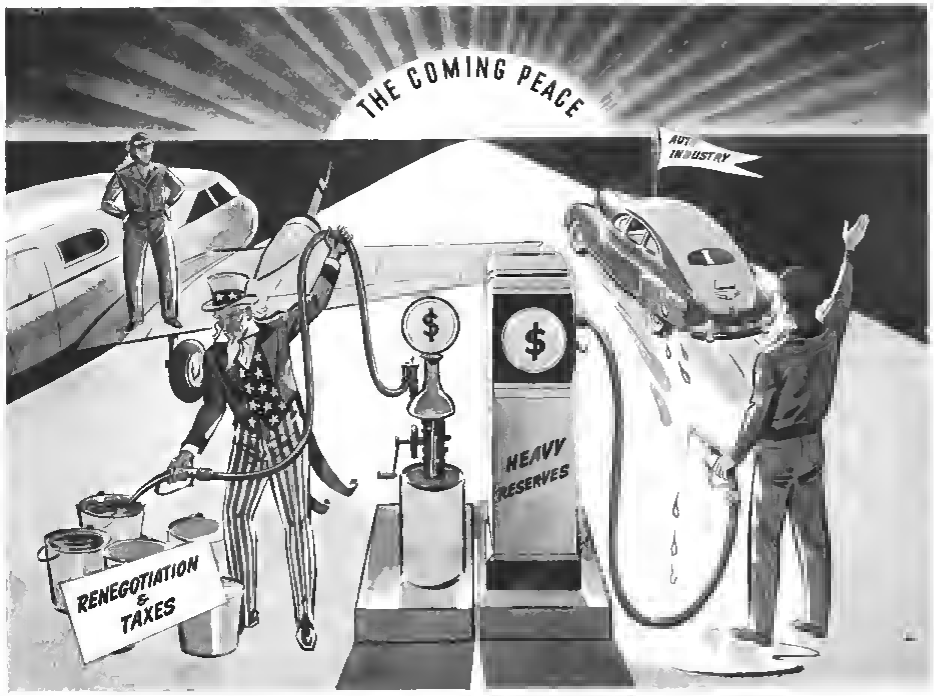
THE SUBJECT of 'excessive' profits in war industries has an insidious habit af bobbing up every so often in certain avenues of pabhe discussion with the aircraft industry invariably selected for special mention as the worst of tha lot. Actually, the airplane manufastaring group seems to have replaced Wall Street as the "whipping boy" of some of our columnists and commentators.

There was, for example, the recent Washington gossip column which pointed out that the "enormous" profits of the plane makers "won't help labor's mood." Then there has been comment to the effect that the excess profits tax is hnt a drop in the hucket and that Congress is still squeamish abont dipping into war profits.

But there is a whale of a difference between actual fact and snch fiction (see Chart 1). In the first year Americe was at war, sales of the 16 primary aircraft companies zoomed from slightly under $1,500,000,000 in 1941 to $4,141,000,000. One might normally expect that such a decided gain in sales volume might well result in higher earnings. At least those stockholders who had ventured their money in aircraft stocks when they were speculative and unseasoned might so expect.

The fact is, however, that net profits of the plane makers in the first war year dropped more than 10 percent—from $102,909,000 in 1941 to $92,045,000 in 1942. Even that doesn't tell the whole story. The majority of aircraft producers have not yet announced completion of contract renegotiation on 1942 earnings.

This means that millions of more dollars will be lopped off the industry's aggregate 1942 earnings before renegotiation is done with. The tabulation of well known aircraft concerns whose 1942 profits were lower last year than in peacetime include Boeing, Consolidated Vultee, Curtiss-Wright, Douglas, Ryan, and United Aircraft. This list will be much longer before the books of other plane makers are finally closed for 1942.

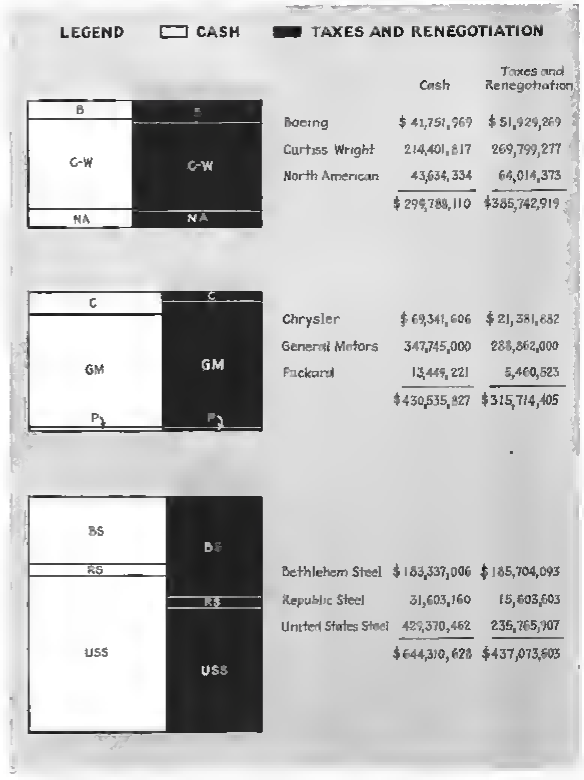


And in 1943, when aircraft deliveries to the armed forces and to lend-lease will have tripled the $4,000,000,000 shipped or flown away from the plants last year, earnings bid fair to record an even further decline from the 1941 prewar levels. Renegotiation officials already have said that the allowable profit on 1943 business after renegotiation probably would be smaller than that permitted in the past. And in 1944, when (barring cutbacks) plane production will be at its peak, Congress is expected to raise corporate income taxes again.

Net income based on sales stood below 3 percent for the industry as a whole last year, whereas it had averaged 5.4 percent from 1934 to 1938 and was, of course, higher than that in some individual cases. In those days aircraft sales were in millions of dollars—not billions—and manufacturers had small but profitable contracts from our Allies-to-be to sustain and nourish them.



CHART 1. Statistics of 16 primary aircraft manufactures show that while '42 sales rocketed over those of '41, earnings and dividends declined. Projection of figures (as fairly accurate "guess tmate") indicate that '43 sales will be between two and three times those of '42, while earnings are expected to be slightly lower and dividends unchanged or a bit lower than '42.



	Cash	Taxes and Renegotiation
Boeing	$ 41,751,269	$ 51,929,269
Curtiss Wright	214,401,817	269,799,277
North American	43,634,334	64,014,373
	$ 299,788,110	$385,742,919
Chrysler	$ 69,341,606	$ 21,381,682
General Motors	347,745,000	288,862,000
Packard	13,449,221	5,460,523
	$430,535,827	$315,714,405
Bethlehem Steel	$ 183,337,006	$185,704,093
Republic Steel	31,603,160	15,603,603
United States Steel	429,370,462	235,765,907
	$644,310,628	$437,073,603

CHART 2. This is a comparison of aircraft, auto, and steel industry end of '42 figures (latest available) on (1) free cash resources and (2) taxes and renegotiation funds owed the government. It is seen that aircraft companies did not have sufficient cash on hand to cover even their debt to government, to say nothing of cash for bookkeeping reserves and other current liabilities. Additional liabilities must be met from inventories and other current assets which, on advent of peace, are likely to shrink to much lower levels. On other hand, auto and steel companies shown (Bethlehem Steel excepted) reported cash covering taxes and renegotiation by very comfortable margins. All nine companies selected are representative with specific aircraft concerns chosen because they have completed renegotiation on their '42 earnings, thus giving accurate picture of what renegotiation has done. Almost all other aircraft companies either have not yet completed renegotiation or have not yet issued amended balance sheets.

But the headline hunters center their attack on profits made on invested capital—not sales. In one such attack Curtiss-Wright was cited as making 41 percent on invested capital in 1941, Boeing 25 percent, and North American Aviation 51 percent. They did. And with the gleam of these big percentages in their eyes, the political writers—as might be supposed—lost sight of the fact that profits must cover risks and

TABLE 1

	Market Price July 43	Price Times '43 Earnings	Profits Per Share
Bell	13½	1 37	$11 78
Boeing	13½	2 43	7 46
Consolidated	13½	2 24	8 43
Douglas	66½	3 60	18 42

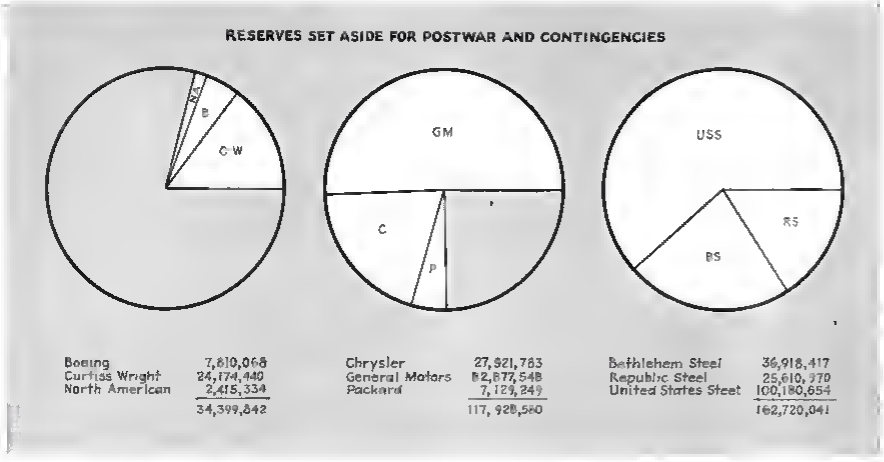


CHART 3. As evident here, the auto and steel industries are fortified with heavy reserves to meet postwar uncertainties—whereas the fact is that they look to several years of peak peacetime operations based upon the huge backlog now accumulating for civilian goods. In contrast, the aircraft industry, which has seen its payroll responsibilities rise from 30,000 workers early in '40 to 1,300,000 today (with estimates predicting 2,000,000 later on) faces the possibility that volume in the first and perhaps second peacetime years may average only around $500,000,000 annually, an Aeronautical Chamber estimate. This would mean yearly sales of but one half the value the industry ships in a single month today.

uncertainties. But risks and uncertainties are proportional to sales and not to capital invested. This is particularly true of an industry that faces such an uncertain adjustment of inventory and rearrangement of personnel and facilities in its transition to peacetime production.

Profits have been characterized by a famous economist as "appraisals of net changes in the position and prospects of the business as a whole—appraisals that look forward to the uncertain future as well as back at the irrevocable past." Moreover, as one prominent industry executive puts it, "all industries are to some extent service enterprises just as a columnist is a service enterprise. His capital investment is probably a typewriter and some office furniture and, unless he is starving to death, his income on his invested capital must be in thousands of percent."

Corporate profits are like batting averages in baseball or the yards gained on the football field, they are meaningless from the standpoint of the aircraft stockholder unless translated into dividends. Only a fraction of net income is finding its way into the hands of the stockholder, as the following figures representing dividends received (as percentages of net income) show: Bell 36 percent, Curtiss Wright 38 percent, Douglas 16 percent, and North American 43 percent.

Dividends last year for the primary producers were $34,447,000 against $37,846,000 in 1942. Lower earnings probably will mean lower dividends again this year, notwithstanding the fact that a recent widely published survey showed a 98 percent gain in aviation company payments in the first half of 1943 over the same period last year. What the survey overlooked was this all-important fact. Only three aviation concerns paid interim dividends in the first half of 1942, the rest postponed such action until late in the year after Congress had revealed the score on 1942 taxes.

So it was that last year nearly all interim dividends were deferred until near the year-end. Then this year Congress gave assurances that whatever corporate taxes were passed in 1943 would not be retroactive. Hence eight of the 18 aviation concerns listed on the New York Stock Exchange felt free to resume interim payments last spring. Nevertheless, the 98 percent increase in dividends for the first half of 1943 stands there on the record—red meat for the political writers. No matter to them that second half dividends will show a corresponding decline.

We have said that profits must cover risks. And one of the leading postwar dangers for business is that of liquidating inventories in process and raw materials at the termination of hostilities. Borrowings to provide needed working capital is a normal corporate procedure when liquidation of inventories is expected to provide money to repay the loans. But, as the National Industrial Conference Board pointed out in a recent survey, the present danger arises from the possibility that postwar liquidation of materials and accounts receivable may entail grave losses.

Some of us can remember how, after the last war, one of the nation's largest meat packing concerns staved off bankruptcy by the skin of its teeth when its inventory losses ran into tens of millions of dollars. And more than ten years passed before that company recovered from its postwar nightmare. The aircraft industry has nearly $1,000,000,000 in inventories on its books today.

It is difficult to appreciate the cost in productive equipment with which the aircraft industry is achieving its spectacular production records. Continuous operation wears down machinery at an abnormally heavy rate. Often replacements are out of the question. Restrictions surrounding the grant of additional depreciation allowances by the Treasury prevent relief from this source. These deterioration costs, which often are not reflected in financial statements, should be taken into account by Congress in determining whether or not current earnings are excessive for contract renegotiation.

The government itself apparently is alive to the inventory chaos that may follow the war. Official attitude of the War Department towards disposal of inventory upon contract termination is

(*Turn to page* 322)

AVIATION'S WAR COMMUNIQUE NO. 22

America at War

Invasion of Italy and its forthwith surrender launches fifth war year as Nazi vitals are targeted within Allied ocean . . . Pacific successes noted . . . Manpower remains big problem at home.

POWER OF ALLIED ARMS, tightly forging a band of steel around Fortress Europa, marked the opening of the fifth year of war. Most significant, that band newly impinged the very neck cords of the Axis as the Allies invaded the Italian mainland and wrested unconditional surrender from that southern pole of the Axis; also additional victories were won on the Russian front. Within the shortening noose highly augmented air power was blasting with new tempo at the German vitals.

New pressure, too, was evident in the Pacific theaters. There was the sweep-out of the Aleutians; the raid on Marcus Island, striking closer than ever to the Jap homeland and bringing first action reports of the Grumman *Hellcat;* further assaults on the Kuriles, telling blows by our 14th Air Force at Canton and Hong Kong, the noteworthy 1,000-mi raid by B-24's upon Nicobar Island off the Burma Coast; paratroop landings in force to bottle the Japs' Lae-Salamaua bases, and the record of 191 enemy aircraft destroyed in the Solomons during August at a loss of a mere 14. Further, the check-off of the Italian navy hastens the day when new American and British naval forces can be sped against Japan.

Meanwhile, this 22nd monthly report finds a major problem back home. Airplane production, now running wide open, is being pressured to get above the level (August) of 7,600 aircraft per month. The limiting factor is manpower, with the worker market now picked clean. We ran out of skilled labor long ago. Then we began training people. Now, all available males suitable for training have been raked in; only a few women over and above those needed to maintain national housekeeping remain to be found.

There are many reasons for the airplane man-power shortage. Army and Navy took too many of the young and alert workers, and they also took too many of the key supervisors, designers, bosses. Better pay in shipyards and in numerous other pursuits generated by the flood of war money attracts workers away from plane plants which are covered by wage ceilings. And there are the country people, initially attracted by the glamour of airplanes and fat pay, who find the jostling and the hall bedrooms intolerable and go back to the old front yard.

But the main problem is that the shelves are bare of workers. Practically speaking, there aren't any more. And much of the additional manpower necessary to run production up to 10,000 per month will have to come out of somebody's hide. Which means that still more ground and sea weapons and supplies will have to be cut back. That is where the rub comes. Officers in command of these services won't let them go without a tussle.

In other words, the high command of the United States (and of the Allied nations) is trying to run a total air war—a strategic all-air war—while it tries also to run a full-scale surface war with all its trappings, afloat and ashore. Our 10,000,000-man Army (minus the Air Forces) and our seven ocean Navy are a heavy burden, even for these incredible United States. But on top of that we have to maintain a fairly wholehearted attempt at air war. Time will tell whether the Allied chiefs are mistaken or not. At present, they themselves are not quite sure enough of their standing to take their feet off the ground and let drive through the air.

Churchill said that it would be worthwhile to try to bomb Europe out of the war. But the all-air people do not admit that it is being tried. It could not be tried, they contend, unless a major portion of Allied energy were put into the production, maintenance, and operation of warplanes.

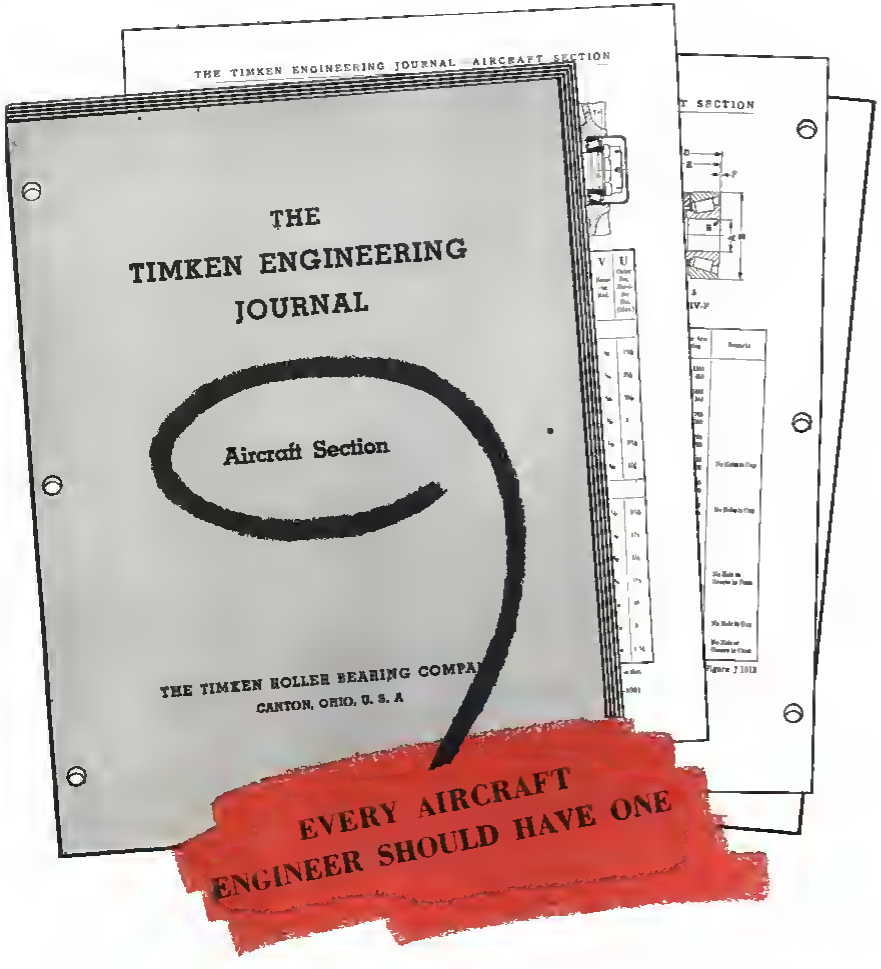
In so far as aircraft production is in competition against other war equipment—the manpower problem is up to the Executive. But there is more to it. Large numbers of capable, draft-exempt males are working at non-essential jobs in production and services for the civil population. Other thousands are working in shipyards and other essential occupations (but less essential than aircraft) simply because they want to. The government has no power (yet) to tell a man where he shall work. This may seem strange indeed, since it has power to put him in a uniform and deprive him of all liberty, even his life. Such power has been under consideration all along, but the people have been against it. However, the solution of the aircraft manpower problem may take the form of a manpower draft bill in the Congress just reassembled. The final solution probably will be a compromise between Executive and Congressional action.

Congress also will have before it several aviation bills of first importance. One of these is HR 1012, drafted to revise the civil aeronautics law. This little document may become the *magna*

(*Turn to page* 342)



One of most versatile of U. S. craft forefronting augmented air smashes at Nazis is new deadlier "fighter-bomber" version of Douglas A-20 *Havoc*. Cannon silhouette view reveals increased fire power of this noted low level bomber strafer which has hung up many enviable records fighting in force in both East and West war theaters.



The Aircraft Section of the Timken Engineering Journal is filled with useful data consisting of typical mountings of Timken Bearing aircraft applications; tables giving the specifications of various series of bearings; notes on bearing selection, lubrication and assembly problems. To get your copy write a letter using the letterhead of your company addressed to The Timken Roller Bearing Company, Canton, Ohio.

TIMKEN
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TAPERED ROLLER BEARINGS

Design Analysis of the FLEETWINGS BT-12



Fleetwings BT-12 has a maximum speed of 168 mph, but it can cruise for five hours at 145 mph only using 65 percent power. Taking off in 917 ft over a 50 ft obstacle and with 10,000 ft climb in less than 11 minutes, this basic trainer has the appearance of a combat plane. Landing over a 50 ft obstacle requires 1,072 ft and the stalling speed is 60 70 mph. Specifications: Wt empty, 3,481 lb, gross, 4,691 lb.; crew, 400 lb; fuel and oil, 810 lb.

By **DAVID BAKER**, *Assistant Editor, "Aviation"*

Detailed study of America's only stainless steel airplane, a basic trainer built for arduous flying conditions and ease of maintenance.

In designing the Fleetwings BT-12 basic trainer, three main objectives dominated all decisions. The first called for a trainer which would retain all the desirable characteristics achieved in previous models of the type, but overcoming their observed weaknesses; the second demanded an airplane which would embody the utmost simplicity of maintenance, and third, a direct comparison on a standard production type of the familiar dural with a material little used throughout an entire airplane—stainless steel.

It is no commonplace job to design a basic trainer. The craft must be a moderately fast and a capable performer to serve as an intermediate step in pilot training. With two cockpits, the airplane must behave consistently with either one or both occupied. It must be inherently safe, yet still be suitable for certain maneuvers as a part of training. In other words, a basic trainer is expected to do all that a bad airplane will do when improperly handled, but do it safely.

This is as complicated a set of requirements as confronts any type. However, data compiled from observation and experience with many trainers at Wright Field pointed the way to some qualities to be striven for in a new design. Although to the casual eye the BT-12 may be just another trainer, fundamental changes have been incorporated which make this airplane advanced in its class and highly suited to its purpose.

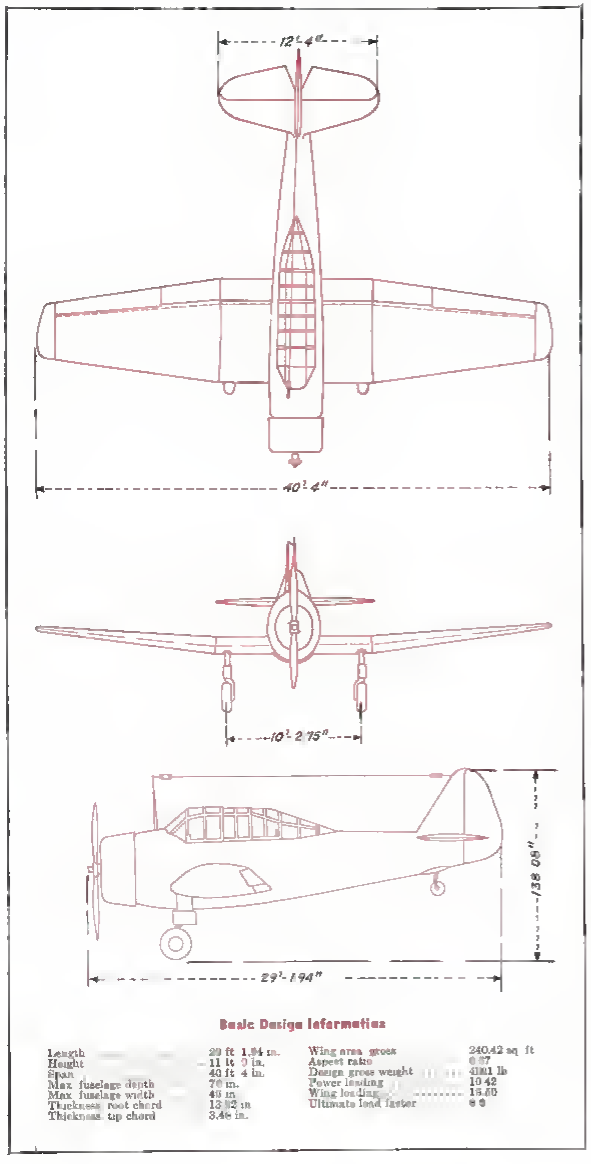
In the first place, the engine has been brought back as close as space permits to the cockpit enclosure, and the sweepback greatly reduced, giving a much shorter range of shift in cg locations. Contributing to this is the incorporation of an integral fuel tank in the wing center section directly under the fuselage. The shift in cg position caused by a full or empty tank is negligible. Shortening the fore section has also greatly improved pilot visibility.

The fuselage has been somewhat enlarged for better streamlining, the tail section slightly lengthened, tail surfaces enlarged, and the fin set farther forward. Considerable "wash out" has been built into the wing (from +1.5 deg. at root to −2 deg. 23 min. at root of tip) to eliminate tip stall. As a result the stalling speed of the airplane is rather indefinite, depending on what is defined as stall. Stall warnings occur

from 88 mph on down, with actual stall from 70 to 60 mph, but the wing tips never stall out

Although the original XBT-12 was designed for retractable landing gear, the classification of BT's and AT's was separated at that time, and the design had to conform with fixed gear. Even though the present model is without fairing on the landing gear, it is exceptionally fast for its type. The XBT had a top speed of 177 mph. with fairing, and the current model attains 168 mph. without fairing, and cruises at 145 to 150, which is about the same as the AT class

It is extremely maneuverable, yet requires the proper degree of precision from the student pilot to execute a maneuver perfectly. Control forces have been intentionally made moderately heavy, to simulate the larger plane characteristics to which the student is progressing. Spin characteristics are good, and conform exactly to the NACA reports on what the design should do. The airplane will recover in the required limits with rudder alone, or with stick and rudder. It will recover with the controls neutral, given a little more space, and the length of time it is kept in a spin does not diminish ease of recovery



Basic Design Information

Length	29 ft 1.94 in.	Wing area, gross	240.42 sq. ft
Height	11 ft 9 in.	Aspect ratio	6.87
Span	40 ft 4 in.	Design gross weight	4001 lb
Max. fuselage depth	76 in.	Power loading	10.42
Max. fuselage width	40 in.	Wing loading	16.65
Thickness, root chord	13 1/2 in	Ultimate load factor	6 9
Thickness, tip chord	3.46 in.		

Maintenance Considerations

Due to the hard usage which is the lot of trainers and, equally, to the large numbers in which they are used, serviceability was set forth by the Army as an essential requirement. Planes and crews tied up in maintenance can slow up a training program as quickly as insufficient aircraft, therefore every effort was made to make this airplane easy to care for

Some of the features in this direction have been described in these pages, most recently in AVIATION Dec. 1942, but they are so numerous that they require fullar coverage

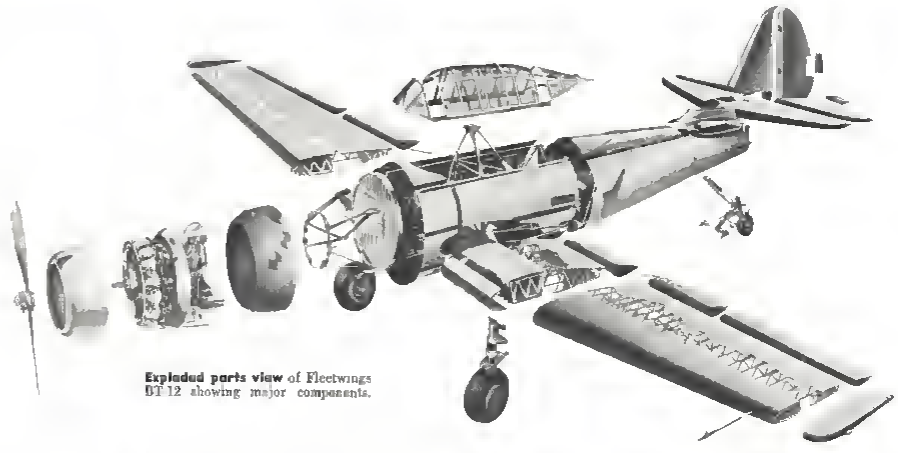
Most extensive provisions for ease of access are the removable fairing panels which cover most of the fuselage. Exception of this idea begins at the nose of the airplane with the ring cowl, which is divided into four sections held in place by four joint strips, fastened by Shakeproof fasteners. Aft of the engine section, all fuselage side panels are removable, and are also held in place by Shakeproof fasteners. The entire airplane can be stripped of removable panels from engine to tail by one man in less than half an hour, giving quick access to frame, controls, and wiring.

Leading edge of the center wing section is also removable for quick inspection of landing gear attachment and fore part of integral fuel tank. Attachment is by means of Phillips screws, as are also the plywood wing tips to outer panels

In line with this policy is the use of

Useful Load

Weight empty	3481 lb
Gross weight	4001
Useful load (crew—400 fuel—720 oil—90 lb.)	1210



Exploded parts view of Fleetwings BT 12 showing major components.

bolts wherever quick detachment is desired, and the diversity of sizes has been kept as close as possible—between AN3's and AN10's. Among points where bolt attachment is used are the following: Landing gear struts are fastened by four bolts each, fuselage to center section by six, fuselage monocoque to tube frame by four at each joint, stabilizer spar to fuselage by four, and fin to tail section by four. Another important application is in attachment of trailing rib sections to wing spars, where ribs are fastened top and bottom by small bolts. This means that only simple tools are required for replacement of these sections in the field

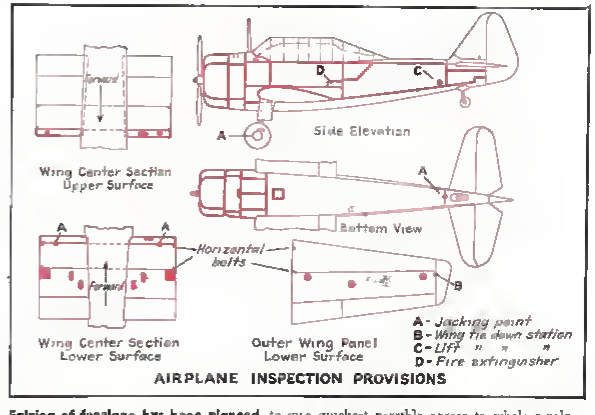
The cockpit canopy is an easily removed and repaired unit, consisting of a 53ST Hunter Sash extruded aluminum frame welded together with gussets. The front windshield panel is a separately removable unit fastened by screws at top and lower front of frame at cowl. Lower corners are fastened to brackets on the longerons by bolts. Remainder of the canopy is composed of two sliding sections over the cockpits, fixed center and rear sections. Each sliding unit can be removed by taking off fairing around lower part of enclosure, aligning rollers on the track with access holes in the frame and removing roller bolts. The entire canopy can be removed by taking off all fairing and unfastening the whole track from the fuselage.

All the transparent panels are set in extruded rubber moldings and can be removed and replaced by hand. Windshield side and center panels are ¼ in. laminated safety glass, all others are ⅛ in. plastic. Emergency exit is provided by means of "knock out" panels front and rear at right side. Movable sections can be fixed at three positions between open and closed.

In the electrical system, circuit breakers have been concentrated in the main junction box located on the left side of fuselage just above the leading edge of the center wing section. This unit is easily reached from the ground by merely removing the panel and cover. Use of conduit plugs wherever possible instead of solder connections has made installation or removal of individual units very simple and fast.

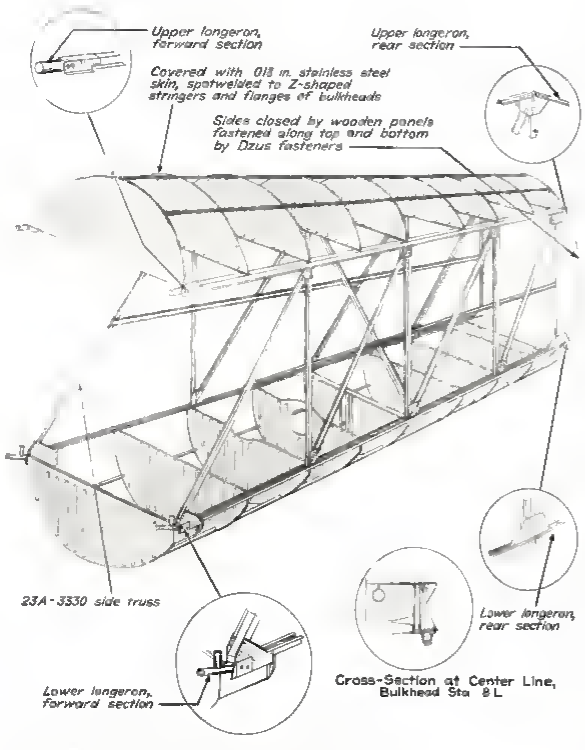
The tool compartment is also made quickly accessible from outside by means of a hinged panel in the plywood fuselage fairing on the left side behind the rear cockpit. It is opened by the same key which operates the canopy locks. A fire extinguisher is also at hand, accessible both from inside and outside, since it is mounted on a spring loaded door in the rear cockpit

All control cable pulleys are packed and self-lubricating, requiring no attention after installation. The elevators, being of symmetrical air-foil section,

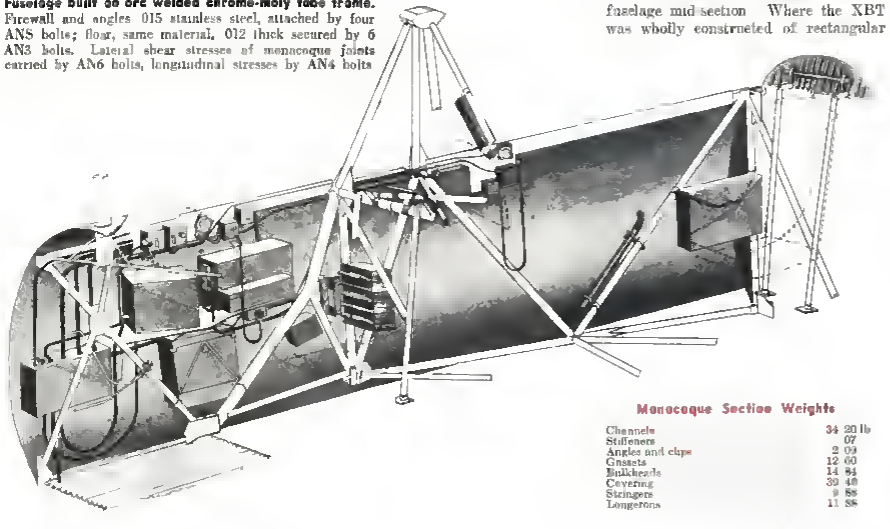


AIRPLANE INSPECTION PROVISIONS

Fairing of fuselage has been planned to give quickest possible access to whole airplane structure. Airplane can be stripped from cowl to tail in less than half an hour. Panels are plywood, fastened by an average of 16 Shakeproof quick acting fasteners per panel. Fairing bulkheads around tube structure are held in place by bolts. Fairing under center section is dural sheet, likewise fairing around the fin. Trapezoidal panel under rear of canopy is hinged at top to give access to tool compartment



Fuselage built as arc welded chrome-moly tube frame. Firewall and angles .015 stainless steel, attached by four AN3 bolts; floor, same material, .012 thick secured by 6 AN3 bolts. Lateral shear stresses of monocoque panels carried by AN6 bolts, longitudinal stresses by AN4 bolts



Monocoque Section Weights

Channels	34 20 lb
Stiffeners	07
Angles and clips	9 09
Gussets	12 60
Bulkheads	14 84
Covering	39 40
Stringers	9 88
Longerons	11 88

have been made interchangeable. This requires a high degree of accuracy in locating and boring holes for the control attachments, but it belves replacement stocks.

Preparation for, and actual engine changing is made easy by adherance to simplified standardized engine connections and attachment of engine-to-mount and mount-to-fuselage by bolts

Stainless Steel Construction

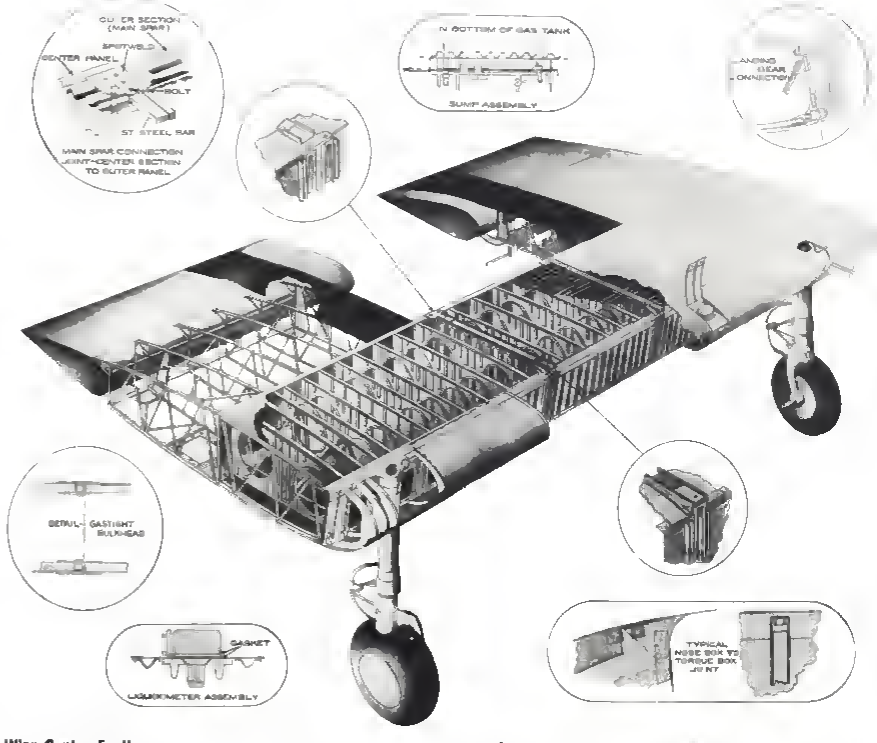
The third design objective—particulars of stainless steel construction and a comparison standard with the same type in dural—leads to the heart of the BT-12 design, for maintenance considerations are inseparably bound up with production methods, and the material used contributes greatly to the trouble-free qualities of the airplane

Before considering each section in detail, it will be profitable to have in mind some comparisons between stainless and dural generally. In stainless steel, .018 gage is about equivalent to 24ST (.040 gage), and steel spotwelds are stronger than $\frac{1}{8}$ rivets in 24ST. In the matter of cost, 24ST comes to about $0.334 per lb, stainless to about $0.66 per lb. Yet such savings can be realized in manufacture, particularly by elimination of riveting, and finishes for detail parts and assemblies, that costs of finished articles delivered are generally lower on a production basis than in dural. This is based on experience with the BT-12, and with tail and control surfaces built for other planes. The reasons will be seen in detailed study of the BT-12

Particularly interesting discoveries have been made in connection with the fuselage mid-section. Where the XBT was wholly constructed of rectangular welded stainless truss framework, the present BT-12 has a chrome-moly tubular frame, and although the latter is as much as 75 percent cheaper in first cost, installation costs in this section have been boosted 300 to 400 percent. In addition, it is 18 lb heavier than the stainless frame.

Looking at it from a purely mechanical standpoint, a tubular framework presents the greatest difficulty to any sort of attachment, in direct contrast to straight sided members. Further obstacles are encountered in manufacture, where welding distortion with chrome moly tubing—even with arc welding—renders a high degree of accuracy far more difficult and expensive to attain than with stainless steel

In connection with welding chrome-moly, an interesting phenomenon has been observed by all users of this type of fuselage frame, and that is its effect on a magnetic compass, for chrome-



Wing Center Section
Constant chart section, NACA 23016, torque box spar .025 stainless steel with .050 cap strips, integral fuel tank. Trailing ribs fabric covered except for metal walkway built into wing and flap, leading edge detachable, fastened with Phillips head screws. Front shear web located at 8.7 percent of chord, rear shear web at 40 percent

Group Weights

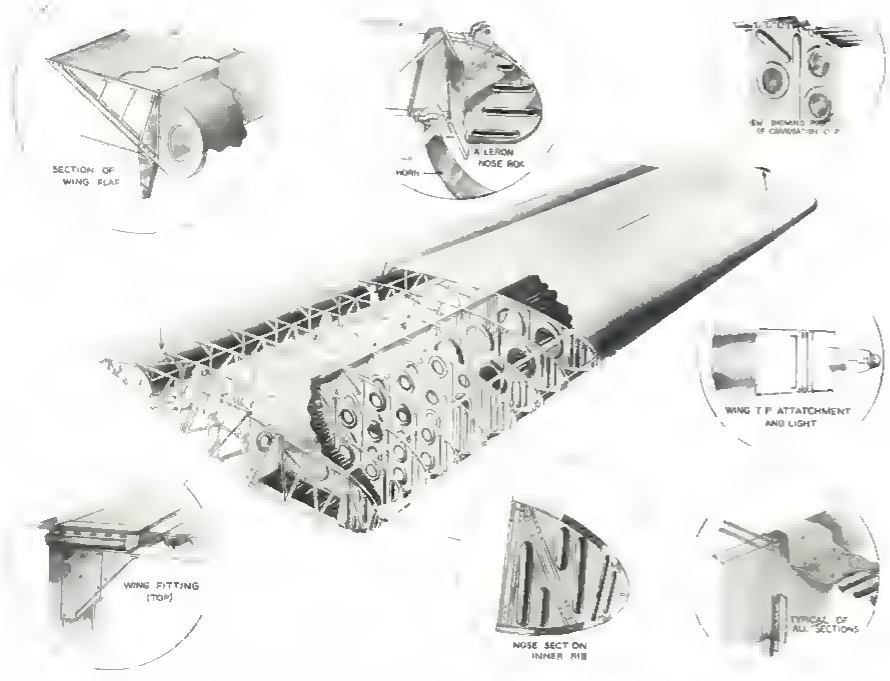
Wing group	737 75 lb	
Center section structure	338 23	
Provisions for equipment	10 53	
Outer panel structure	292 09	
Provisions for equipment	2 42	
Wing tips	3 62	
Ailerons (counterweight 8 4)	28 54	
Flaps	43 33	
Gas strips nuts, bolts	11 97	
Tail Group	188 03 lb	
Stabilizer	53 0	
Elevator (counterweight 8 36)	31 23	
Fin, structure	21 36	
Provisions for equipment	1 31	
Rudder (counterweight 2 16)	19 53	
Provisions for equipment	1 60	
Body Group	512 93 lb.	
Fuselage less engine	503 0	
Provisions for equipment	9 92	
Landing Gear	386 53 lb	
Main	341 31	
Tail	45 02	
Nacelle Group	98 41 lb	
Power Plant Group	1017 21 lb.	
Engine as installed	659 43	
Accessories	75 73	
Controls	16 57	
Propeller	105 57	
Starting system	46 51	
Lubricating system (tanks and protection—12 0; piping, etc—30 59)	82 09	
Fuel system (pump only—7.8, piping, etc—25 31)	33 11	
Fixed Equipment Group	578.06 lb.	
Instruments	62 75	
Surface controls	104 14	
Electrical system	133 62	
Communicating	72 74	
Personal accommodations	71 26	
Emergency action solutions	0 17	
Provisions for flight	12 75	
Air conditioning equipment	45 72	
De-icing equipment	3 90	

Unit Weights

Wing group (gross area 240 42 sq. ft.) 3 07 lb sq ft
Tail group (gross area 43 0 sq ft.) 2 03 lb sq ft
Weight of lubricating system per gal oil 5 21 lb.
Weight of fuel system per gal gas 28 lb

Load Factors

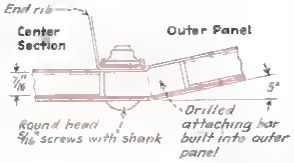
Limit maneuver load factors	positive 5 07 negative 2.33
Limit gust load factor	
Design gross weight	positive 4 18 negative 2.71
Min. flying weight	negative 3.34
Limit landing load factor wheels	4
Float diving speed	250 mph



Wing outer panel, stainless steel, built round main spar, thickness .030 to .025. Front spar, leading edge formers and stamped ribs, trailing ribs and top skin, .010 thick. Leading edge skin, .020 to .016 thick.

moly is inherently magnetic. Use of arc welding, almost dictated by demands of accuracy and production time, further increases the tendency. Add to this the effects of magnaflux for inspection—even with every attempt at demagnetization—and the result is 30 to 40 deg. compass error and, in some cases, a completely "frozen" compass. The only recourse is to mount a remote reading compass in another part of the airplane, as was necessary in the BT-12 and many others. Since stainless steel (grade used here is 18 and 8) is austenitic and almost wholly non-magnetic, it allows perfect accuracy of compass within the frame.

In summary on stainless steel, it may be generally stated that wherever stress is concentrated, a structure of this material is usually superior due to its strength-weight ratio and freedom from corrosion deterioration. In manufacture, the ease with which it is welded without cleaning or preparation, simplicity of jigs in which hand tong weld ing can be accomplished, and the resultant infinite possibilities of subassembly application, more than compensate for a nearly-double first cost of material which, after all, constitute only about 10 percent of the finished airplane cost. Chief drawback in its use is the fact that it cannot be routed with present tools, due to its hardness.



Front view of lower wing panel attaching bar which holds outer wing (right) to center section (left). Bar is spot welded to outer wing and is held to center section by round head screws seen at bottom. Front spar webs are bolted together, while a corresponding strip attached to outer panel in rear matches rear spar web of center section.

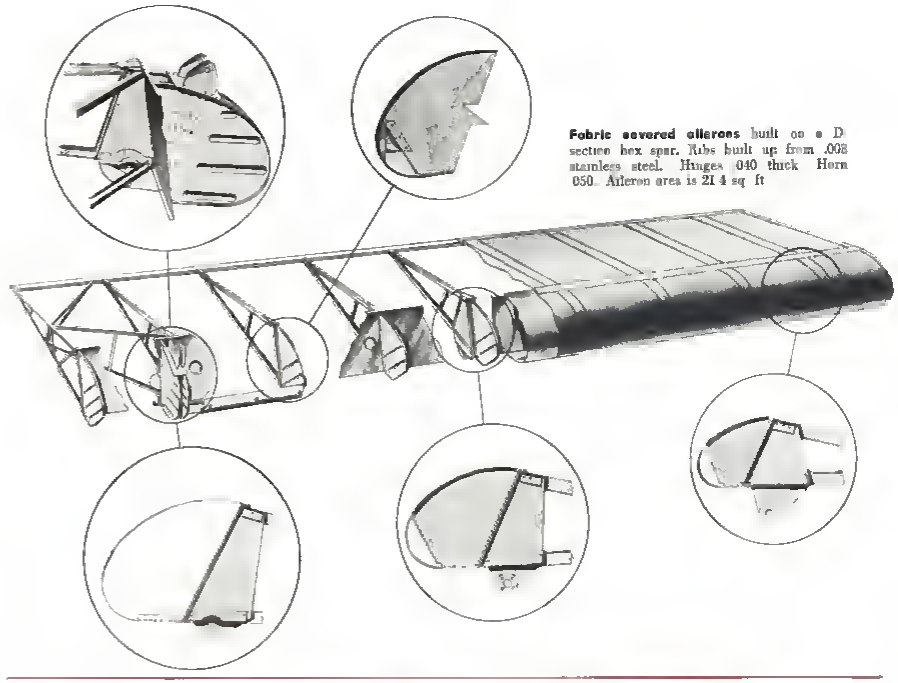
Fuselage

Except for the chrome-moly tubular framework in the cockpit region, the fuselage is of spot welded stainless steel construction. Length without engine mount is 259.5 in., with mount, 283.26 in.

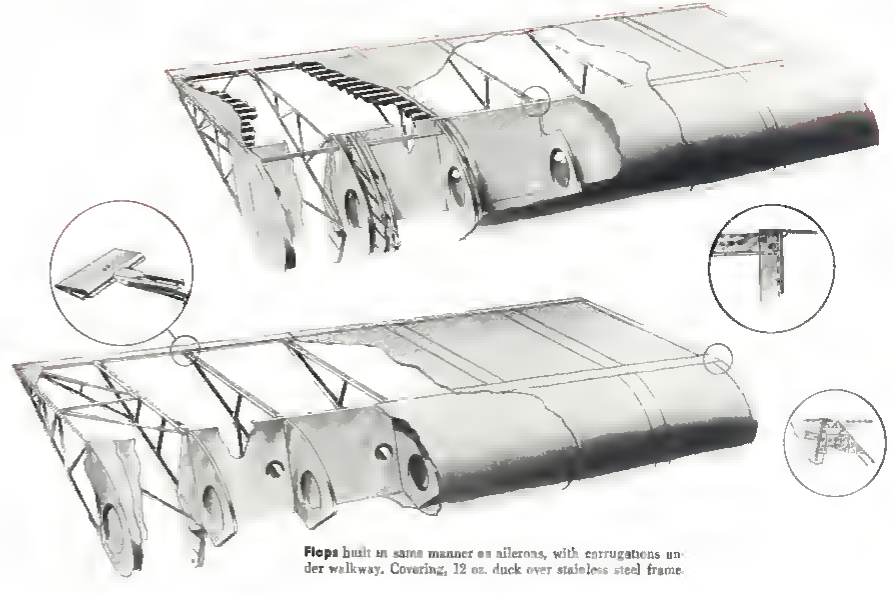
The firewall and angles are annealed and formed. Tensile strength of annealed stainless is about 80,000 lb; average forming operations bring it up to about quarter hard, or 125,000 lb. More severe forming raises it slightly higher. For slight forming operations the material is used half or quarter hard, for severe forming it is used full annealed. Parts which are not formed are full hard (185,000 lb.) and this is used nearly everywhere throughout the plane.

Where the engine mount bolts to the fuselage and firewall, four conical aligning studs are provided to aid in matching the bolt holes. The tubular section is provided with six bolt holes for attachment to the center wing section.

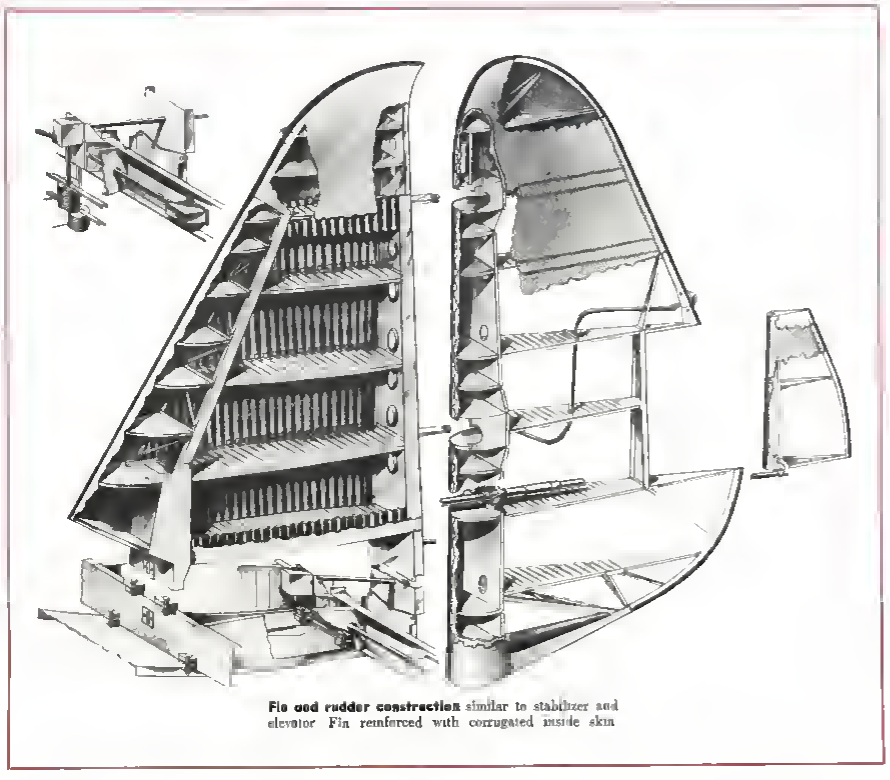
In the aft monocoque structure bulk-



Fabric covered ailerons built on a D section box spar. Ribs built up from .008 stainless steel. Hinges .040 thick. Horn .050. Aileron area is 21.4 sq. ft.



Flaps built in same manner as ailerons, with corrugations under walkway. Covering, 12 oz. duck over stainless steel frame.



Fin and rudder construction similar to stabilizer and elevator. Fin reinforced with corrugated inside skin

heads are camber formed. Contrary to general belief, stainless is quite easily adaptable to this technique, and parts made in this manner include wing leading edge formers, bulkheads, and wing ribs in the D-spar section.

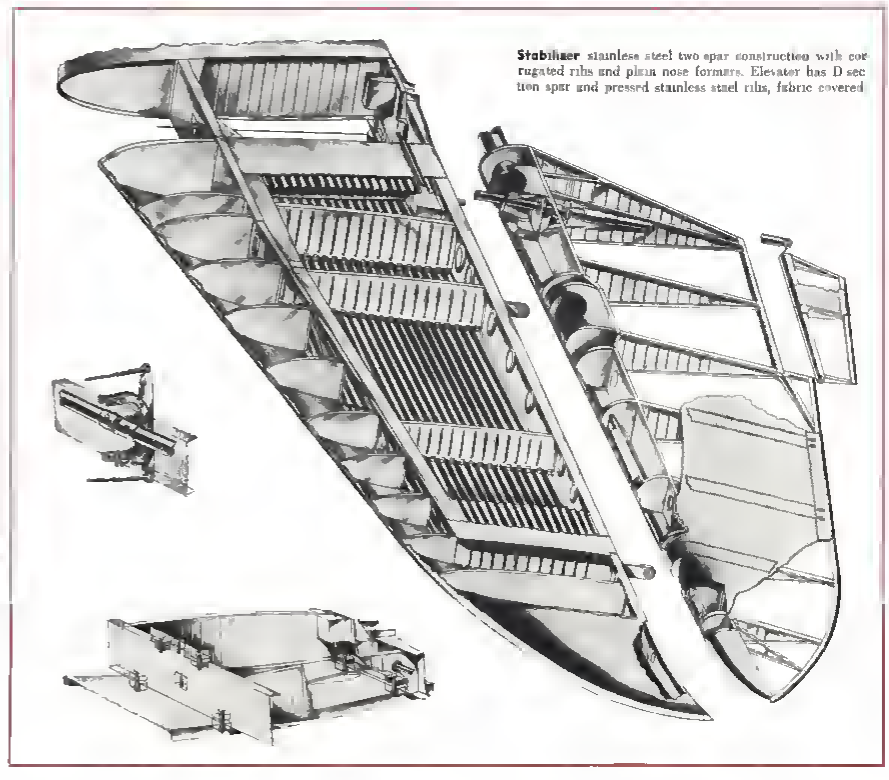
Upper and lower monocoque coverings are stressed skin structural members. Except for bolt attachment to the tubular frame, this structure is spot welded throughout, the side truss framework being welded together as a unit in the jig. Vertical, diagonal, and horizontal members are "hat" sections made on a draw bench. The upper rear shear panel is annealed sheet, with welded-on pads to take the stabilizer spars. The tail post is also formed annealed. A shelf just aft of the tube structure forms the tool compartment floor. The lower rear covering, with tail wheel opening, is annealed stainless sheet formed under drop hammer. Covering of the fuselage is plywood except for the engine section and fairing under the center section from the engine accessory section aft to the monocoque. This is dural sheet, to better withstand ground abrasions and knocks, as well as accumulations of oil, dirt, gas, water, etc.

Center Wing Section

Most striking example of what has been done with stainless construction is use of the structural space in the torque box of the center wing section for an integral fuel tank which has proved one of the most successful of this type. First attempts at construction by spot welds and solder were not very successful, but the seam welding technique, which is actually a series of overlapping spot welds performed by roller electrodes, has effectively solved the problem. Tanks remain leakproof in use, and under Army vibration tests—except for some trouble with the aluminum sump attachment which was soon corrected—the tank outlasted the test table.

Skin and corrugation in fuel-tight bulkhead are seam-welded through flanges of front and rear spars. End bulkheads are seam welded through reinforcing plates to a U-shaped member on its side, which forms the joint between inner and outer reinforcing plates, bulkhead, and covering on each side of the bulkhead. The sump at bottom of the tank is an aluminum casting bolted into a formed stainless steel collar. Two stand pipes into the tank provide for main and reserve fuel supply. The filler neck is accessible through a hinged flap in the leading edge, which is itself removable for inspection of forward spar and tank.

Center trailing rib section is made to be easily removed or replaced, the ribs being bolted to the rear face of the rear spar. A walkway next to the fuselage is also built into the wing flap at this point. Covering of these ribs is by flush fitted fabric, fastened down into M-section capstrips by an 0.008 gage stainless retaining strip over reinforcing tape secured by flat head sheet metal screws and covered by tape strips.



Stabilizer stainless steel two spar construction with corrugated ribs and plain nose formers. Elevator has D section spar and pressed stainless steel ribs, fabric covered

Outer Wing Panels

Outer wing panels are of stainless, D-section monospar construction with a flush fabric-covered trailing rib section aft of the spar. The outer panels are joined to the center section by stainless steel bars at top and bottom, fastened by ¼ in. screws and channel nuts. The web of the outer spar bolts to the rear spar of the center section, and a reinforced vertical angle piece welded to the outer wing bolts to the web of the front center section spar, thus giving attachment around four sides of the center torque box. The joint is further strengthened by finger plates which underlie the attaching bars at top and bottom, and they are welded back to the corrugation for several inches. The stainless skin butts up flush, while to the rear, gap strips cover the joint.

Spar section ribs are rubber press-formed annealed stainless, reinforced at the flange caps by narrow strips of the same gage welded inside upper and lower flanges. Skin and corrugation

Airfoil Data

Root section	NACA 23016
Tip	NACA 4408
Root chord	7 ft 3 in.
Tip chord	3 ft 8.22 in
Taper ratio	2:1
Angle of incidence, root	1.5 deg
Angle of incidence, tip	—2 deg
Dihedral (measured on top face of front beam)	5 deg.
Sweepback L.E.	7 deg.
Max. rib spacing	12 in.
Spar locations	
Main shear web, root 40% of chord, tip, 30% chord	
Aspect ratio	6.8
M.A.C. length	75 in
Location, 6 in. aft of L.E. at root chord	
4.2 in. above f.E. root chord	
Aileron location (distance from plane of symmetry to centroid of aileron area)	14 ft 7 in

Empennage Data

Stabilizer span	12 ft 4 in
Max. chord (to center line of elevator hinge)	35 in
Stabilizer area (less elevators)	22.74 sq. ft.
Airfoil section	NACA 0009
Angle of incidence	1.0 deg
Elevator chord, max.	25.5 in
Elevator area (total including tabs)	18.56 sq. ft.
Elevator trim tabs area	2.38 sq. ft
Fin area	8.35 sq. ft
Angle of incidence	1 deg. left
Rudder area, including tab	12.94 sq. ft
Tab area	1.06 sq. ft

Control horn, aluminum alloy 6ttng.
Covering, linen fabric

Empennage Materials Data

Stabilizer—Stainless Steel Gages

Main spar	
Front spar caps—.030, diagonals—.020	.025
Stamped ribs	.012
Leading edge skin	.020
Bow tips	.018
Corrugation	.010
Skin	.010
Hinge brackets, riveted dural plate, 7.32 in.	
Attachments, spars to fuselage 4 AN-5 bolts	

Elevators—Stainless Steel Gages

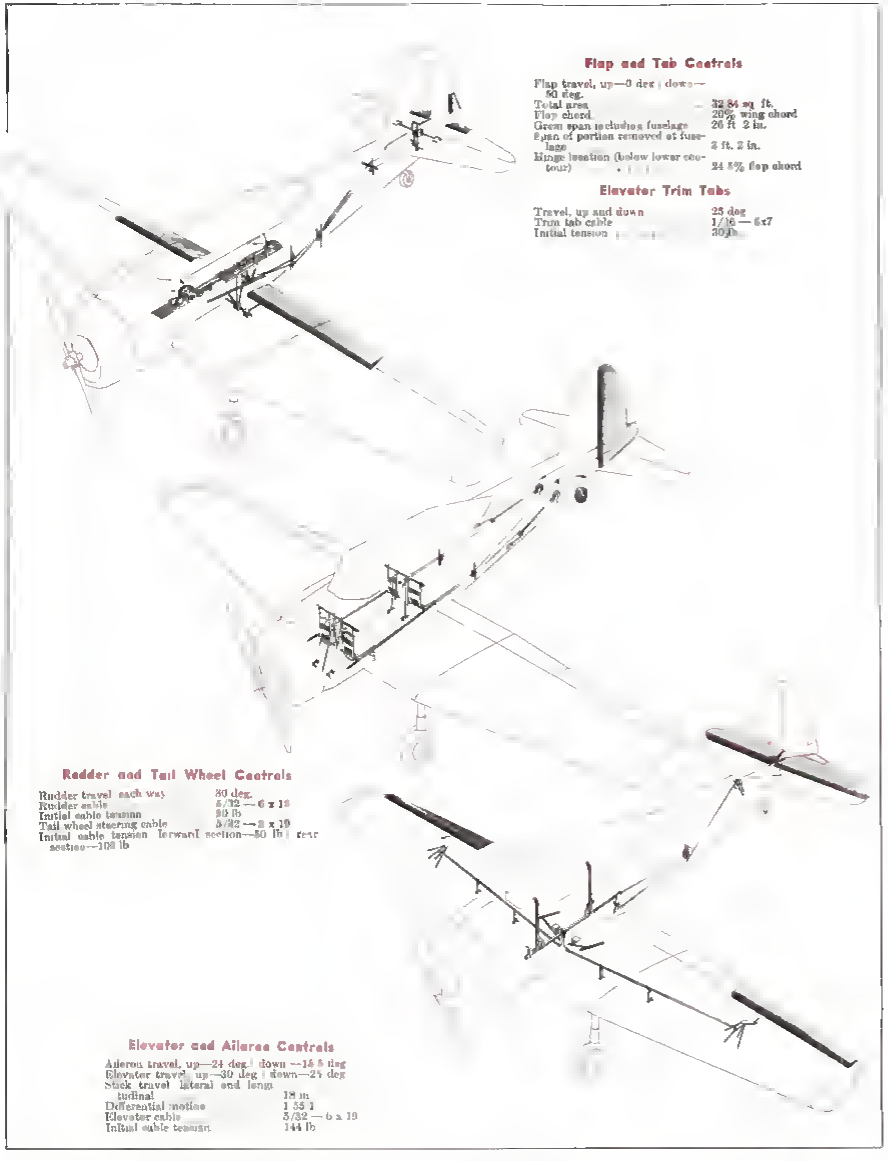
Spar	.020
Trailing rib, stamped	.010
Leading edge skin	.020
Trailing edge	.014
Tabs, frames—.010, trailing edge—.014	

Fin—Stainless Steel Gages

Lower front spar	.025
Built up portions, front spar caps—.030, diagonals—.020	
Main spar	.025
Ribs	.015
Leading edge skin	.013
Skin and corrugation	.010

Rudder—Stainless Steel Gages

Spar	.025
Stamped ribs	.010
Leading edge skin	.025
Trailing edge	.014
Rudder horns	.030
Tab frame—.010, leading edge—.012, trailing edge—.014	
Covering, fabric	



Flap and Tab Controls

Flap travel, up—0 deg ; down—50 deg.	
Total area	32.84 sq. ft.
Flap chord	20% wing chord
Gross span including fuselage	26 ft. 2 in.
Span of portion removed at fuselage	3 ft. 2 in.
Hinge location (below lower contour)	24.5% flap chord

Elevator Trim Tabs

Travel, up and down	25 deg
Trim tab cable	1/16 — 6x7
Initial tension	30 lb

Rudder and Tail Wheel Controls

Rudder travel each way	30 deg.
Rudder cable	5/32 — 6 x 19
Initial cable tension	50 lb
Tail wheel steering cable	5/32 — 2 x 19
Initial cable tension forward section—50 lb ; rear section—108 lb	

Elevator and Aileron Controls

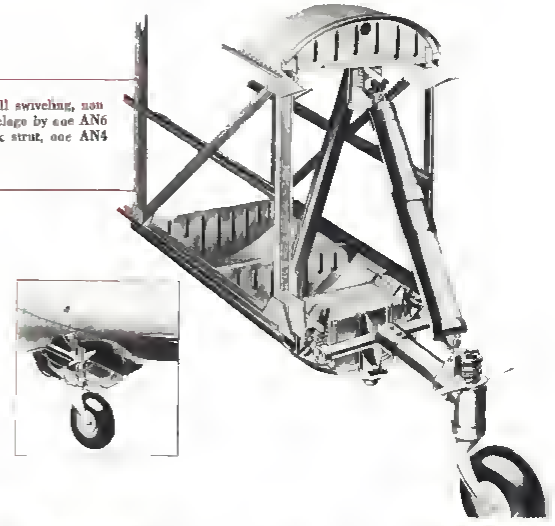
Aileron travel, up—24 deg ; down—14.5 deg	
Elevator travel, up—30 deg ; down—24 deg	
Stick travel lateral and longitudinal	18 in.
Differential motion	1.55:1
Elevator cable	5/32 — 6 x 19
Initial cable tension	144 lb

are welded together before application by a rolling welder which spot welds the skin to two rows of the corrugation at a time.

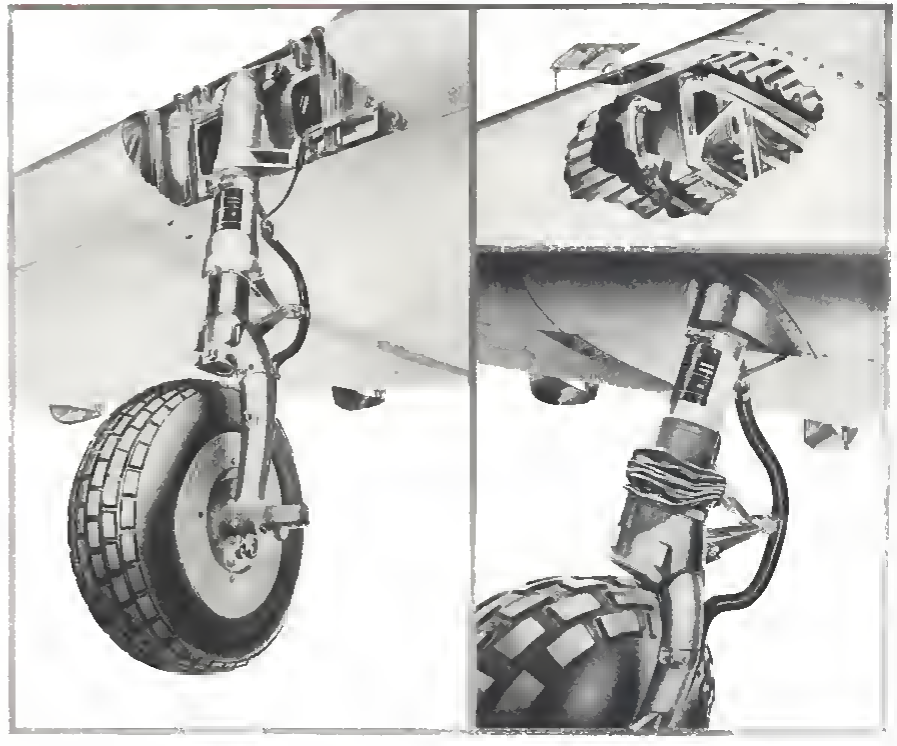
Finished sheets of skin and corrugation are applied as a unit. Ribs are fastened to the corrugation by means of annealed stamped clips, which are first welded to the corrugation before application of the skin. Ribs fit into the clips and are welded in place. This method, used throughout the airplane, makes a strong homogeneous structure.

Trailing edge ribs are built-up members and are connected at the rear by

Tail wheel is steerable, full swiveling, non retractable, attached to fuselage by one AN6 bolt at upper end of shock strut, one AN4 bolt at each side of yoke.

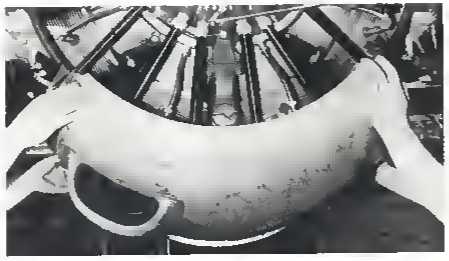


Landing gear is attached to center section spar by four AN10 bolts. Present models are without fairing. When in service, moving parts of shock leg are protected by flexible canvas cover.

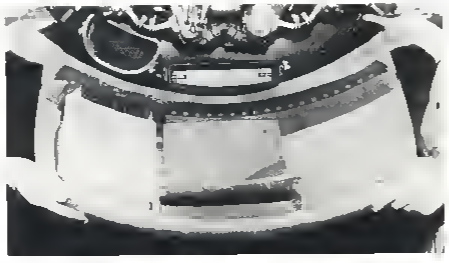




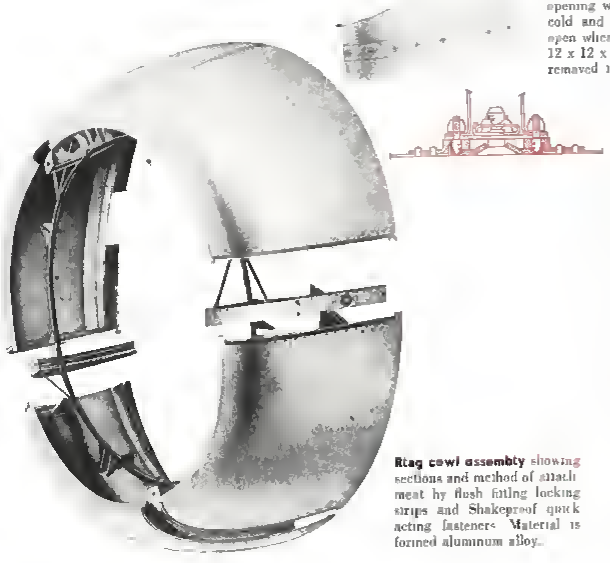
Engine mount is attached to fuselage by four ½ in. drilled head bolts. Detail drawing shows position of conical aligning studs for lining up the bolt holes when attaching mount. Engine can be detached with or without mount.



Lower section of ring cowl illustrating built in duct for oil cooler. An internal duct right beside it feeds carburetor scoop, while above in upper section is blast tube for cooling accessory compartment.



Noteworthy feature of this installation is carburetor air mixing chamber, of Fleetwings design, which is a one piece aluminum casting. Lower scoop draws in cold air from inside front lip of the cowl, while upper inlet draws warm air from behind cylinders. A shutter in this aperture automatically bypasses this air stream outside opening when it is not being used by carburetor. Both cold and warm air shutters work together, one being open when the other is closed. This chamber also houses 12 x 12 x 2 in. flat type air filter, which may readily be removed through door in rear.



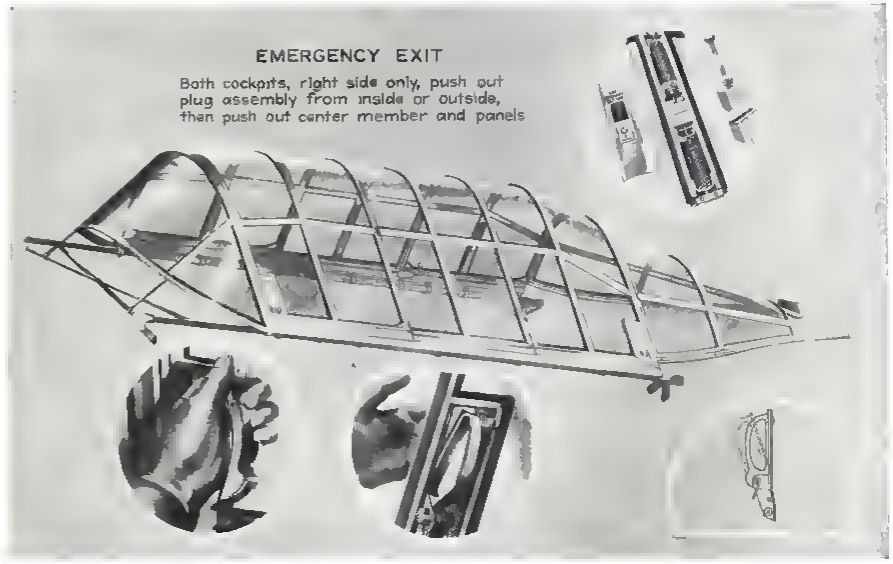
Ring cowl assembly showing sections and method of attachment by flush fitting locking strips and Shakeproof quick acting fasteners. Material is formed aluminum alloy.

a false spar to distribute concentrated loads from hinge ribs to adjacent ribs, and to provide contour for fabric covering. Aileron hinge brackets are made up of two stainless plates, one of which is stamped into a hat section over which is welded the other flat plate. The stamped piece is annealed, the flat plate is full hard. Hinge bearings throughout the airplane are self aligning ball bearings. Hinge pins are all standard AN4 clevis bolts.

Plywood wing tips are detachable, fastened to the outer panel by Phillips head screws. Fastening strip of the wing tip fits over a recessed strip on the outer panel, bringing the wing tip flush with the rest of the wing. Construction is of poplar core two ply mahogany, ⅛ in. thick, with a bow member and four web and cap forming ribs.

Ailerons

Ailerons are Frise type, torque box, flush fabric covered, with annealed



Canopy assembly with details of emergency exits and attachments. Frame is 53ST extruded aluminum, front and side windshield panels safety glass, all others plastic.

stamped leading edge ribs and built up trailing ribs. Although the forward box section is stainless covered, fabric is wrapped over the whole aileron. There is one trim tab on left aileron. Aileron horns consist of two full hard stainless plates welded to nose ribs and protruding through the nose skin.

Wing Flaps

Flaps are of the same construction as the ailerons, but are divided into center and outer sections, due to dihedral angle at the joint of the center section and outer panel. A stainless steel walkway of corrugation with skin covering is built into the inboard end of the center section. Upper surface of this section is flush fabric covered, while the under surface is covered with twelve ounce canvas duck to withstand the impact of stones or other objects thrown up during landing or takeoff. The outer flap sections are flush fabric covered both top and bottom. Control horns are similar in design and construction to the aileron horns.

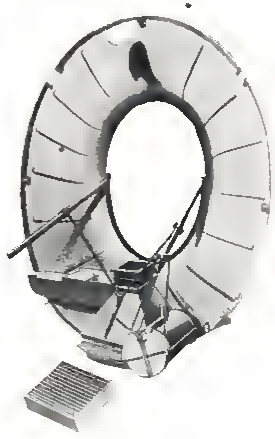
Empennage

The horizontal stabilizer is built in identical halves welded together, with two spars which attach to the fuselage by four bolts, two through each spar. Construction is essentially the same as that in outer wings except for the stabilizer tips, which are annealed stainless steel formed under drop hammer. Elevator hinge brackets are of rolled dural plate, bolted to the stabilizer by two bolts each. They are equipped with self-aligning ball bearings. Hinge pins are the standard ¼ in. clevis bolts.

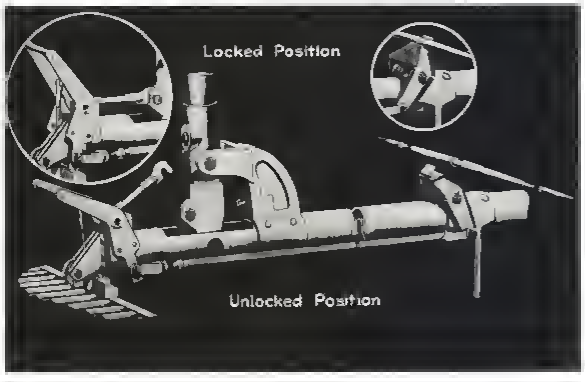
Elevators

Of single torque box construction, the elevators have stamped trailing ribs and fabric covering. The method used for covering on the tail surfaces is different from that on the wings, being the conventional non flush lacing. Trailing edge





Front and rear views of collector well and ducts.



Details of the parking lock, which locks brakes and controls.

ribs are rubber press formed, annealed stainless, reinforced where required, with full bead stainless angles under the flanges. Trim tabs are of the same type construction as the elevators.

Fin and Rudder

Four bolts hold the fin to the tail section, two from the front lower fin spar to the front stabilizer spar, and two from the rear spar to the tail post. Fin ribs are stamped stainless, covering is stainless corrugation and skin. Fairing between fin and stabilizer and fuselage is dural sheet fastened by brazier head screws and channel type stop nuts. Rudder hinge brackets are also dural, two of which are attached to the rear fin spar and one to the tail post.

Rudder construction is similar to that of the elevators, with stamped ribs, stainless leading edge, and conventional fabric covering. The trim tab is of similar construction.

Surface Controls

Conventional dual stick and rudder pedals control ailerons, elevators, rudder, and steerable tail wheel. Ailerons are actuated by rods and bell cranks, elevators and rudder by cable.

Wing flaps, elevator and rudder trim tabs, are controlled by a crank and wheels respectively, arranged about a common shaft at left side of both cockpits. Motion to the wing flaps is transmitted by means of miter gears and torque tubes with screw actuators at flaps. Elevator and rudder trim tabs are moved by means of small cable-wound drums on the cockpit control shelves, which transmit their motion by cable to two corresponding drums in the tail of the ship. These turn shaft and gear mechanism with screw actuators which move the tabs. Elevator cables fasten to a common control horn mounted below the fin. Both elevator torque shafts fit into sockets at this point and are controlled as one.

Landing Gear

Single leg, half fork, air-cooled struts are used on the fixed landing gear. Interchangeable wheels are aluminum alloy castings, equipped with Bendix hydraulic brakes and mounting 27 in. smooth contour tires designed for 32 psi. Moving sections of the shock leg is covered by a flexible canvas cover to exclude dirt. Axles are steel tubes, also interchangeable left and right.

Tail gear is a steerable, full-swiveling non-retracting wheel on a half fork with air-oil shock strut fastened to the fuselage at its upper end by one bolt. The yoke is fastened by a bolt at each side. Tail wheel tire pressure is kept at 45 psi.

Engine and Accessories

Power plant is a Pratt & Whitney Wasp Junior of 450 hp at 2300 rpm, with direct drive to a Hamilton Standard two blade, two position controllable pitch propeller of 8 ft. 9 in. diameter. Pitch settings are 17 deg 45 min high and 13 deg 30 min low. Minimum clearance of propeller is nine inches from the ground in level landing position, and one inch from the cowl at maximum pitch setting.

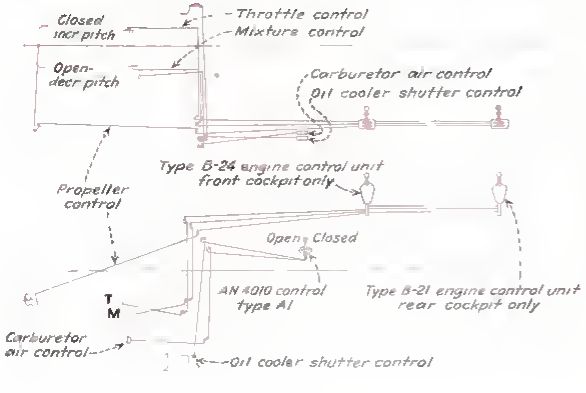
Fuel system consists of the integral center section tank, dual controlled selector valve for main and reserve supply, wobble pump, one fuel strainer, an engine driven fuel pump, and a hand primer in the front cockpit. Both instrument panels are provided with fuel pressure gages and warning lights, but the fuel quantity gage is provided only on the front panel.

Oil system includes an aluminum tank built in two pieces welded together. It is constructed with a built-in hopper type accelerated warming compartment. Pressure and temperature are read on the engine gage unit on both instrument panels. Temperature regulation is by means of a D-5 thermostatic valve and controllable shutter on the oil cooler. There is an electrically operated oil dilution system for cold weather starting.

Electrical system is a single-wire 12v grounded return type, except where a two-wire parallel return system is necessary to eliminate magnetic effect on the compass. A type D 6A battery is installed in the fore fuselage behind the

(*Turn to page 356*)

ENGINE AND PROPELLER CONTROLS SYSTEM DIAGRAM





Moisture Resistance Is Important to You



THE AVIATION INDUSTRY *OK's* SYNTHANE

BAKELITE-LAMINATED for:

LIGHT WEIGHT with Strength
LIGHT WEIGHT with Corrosion Resistance
LIGHT WEIGHT with High Dielectric Strength
LIGHT WEIGHT with Ease of Machining

MOISTURE resistance sometimes means as much in the performance of materials as it does to a duck. For example, moisture absorption is often a barometer of usefulness for many of the other combined properties of Synthane. Because Synthane has low water absorption, its power factor and dielectric strength change very little with changes in humidity—indispensable requirements for insulation against radio frequency currents in aircraft instruments. Synthane's low moisture absorption also minimizes cold flow, dimensional changes, and the penetration and corrosive action of water, aviation oils and gasolines. For a more complete report of the relation of Synthane's low moisture absorption to other advantages you need, we urge you to read the back of this sheet.

SYNTHANE CORPORATION, OAKS, PENNSYLVANIA

Materials to remember, specify and use for Aircraft Parts

SHEETS • RODS • TUBES • FABRICATED PARTS

SYNTHANE

Bakelite — laminated

MOLDED LAMINATED • MOLDED MACERATED

SYNTHANE *vs.* Water ABSORPTION

Water can influence the physical, mechanical, electrical and chemical properties of many materials. Whether the effect of water is to be regarded as of consequence depends on the resistance of the material itself and the nature of the application.

There are many cases in which Synthane is used because it not only has certain needed properties, but also because its moisture resistance keeps these needed properties stable and usable.

A few examples will illustrate the point:

Effect on Electrical Properties

In high frequency and intermediate frequency radio circuits, it is desirable to have insulation of low power factor and high dielectric constant. But it is of even greater importance that the power factor and dielectric constant should not change appreciably with variations in humidity. An increase in the power factor or dielectric constant reduces the sensitivity of the set and lowers the selectivity (ability to separate stations).

Insulation resistance, or the measure of the leakage current flowing between terminals imbedded in or in contact with the insulation, also decreases with the absorption of moisture from the atmosphere. This is of interest to manufacturers of telephone, electronic, radio, electrical testing or any precision equipment dealing with minute currents.

Dielectric strength is also lowered by moisture absorption though this effect is of more moment to makers of general electrical apparatus and radio transmitters.

Synthane is supplied in a variety of grades with the proper electrical properties for any given use and with low moisture absorption to maintain their stability.

Effect on Chemical Properties

The mere fact that a material absorbs water does not necessarily affect its corrosion resisting properties. The point is that if a material will absorb water, then it will absorb corrosive chemicals, gases, solvents, etc. The greater the absorption, the more harmful the corrosive effect is liable to be. Water absorption is therefore useful as one index of corrosion resistance, a measure of the extent to which a corrosive agent can penetrate, saturate and attack.

Synthane is made in a number of grades employing corrosion resisting bases or resins or both, depending on the nature of the corrosive agent to be resisted. Regular standard grades are unaffected by oils and usually offer ample resistance to corrosive agents found in natural waters.

Effect on Mechanical Properties

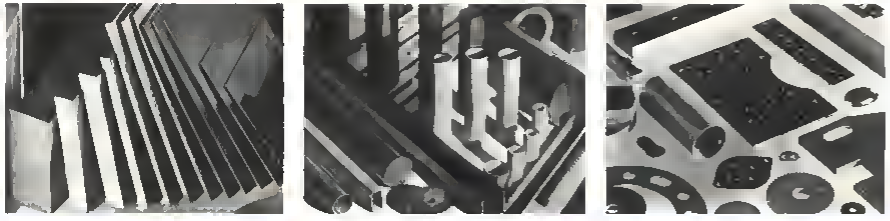
The ability of Synthane to resist water absorption has a noticeably good effect on its mechanical properties. Water reduces the compressive, flexural and tensile strengths if absorbed in any quantity. Cold flow also varies very widely with the degree of moisture present. Fortunately, water absorption is low in all grades of Synthane, extremely low in certain grades recommended for that purpose.

Effect on Physical Properties

Of the possible effects of water on physical properties, the only one with which you are likely to be concerned is the effect on dimensional stability.

Standard water absorption tests are generally conducted on samples of Synthane 1" x 3" x $\frac{1}{16}$", with distilled water at room temperature for 24 hours. Naturally, these tests are only indicative of water absorption or dimensional stability. But they show that dimensional increase is somewhat proportional to the percentage of water absorbed, and that swelling takes place at the edges first, then gradually works inward. In other tests, in our laboratory, using discs 2" in diameter by $\frac{1}{8}$" thick, after immersion for two years in distilled water at room temperature, the following variations in dimensions were noted.

Center swell varied from .0023" to .0084", depending on the grade tested. The diameter increases were from .0008" to .0050" in one direction and 90° of the first direction from .0025" to .0103". These tests represent extreme conditions. Synthane is not often involved in applications requiring total and continuous immersion, and even then, dimensional changes may not be as important as other factors.



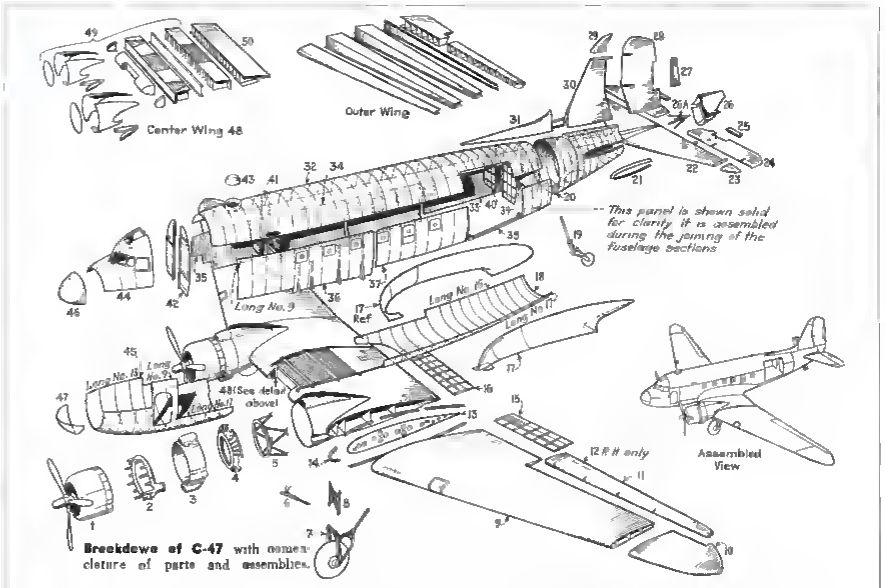
FLAWLESS PRESENT AND FUTURE PRODUCTS WITH SYNTHANE TECHNICAL PLASTICS

SYNTHANE
Bakelite—Laminated

SHEETS-RODS-TUBES FABRICATED PARTS MOLDED-LAMINATED OR MOLDED MACERATED

SYNTHANE CORPORATION, OAKS, PENNA.

REPRESENTATIVES IN ALL PRINCIPAL CITIES



Breakdown of C-47 with nomenclature of parts and assemblies.

1	Power plant propeller anti-drag ring	11	Aileron	21	Fillet (horiz. stabilizer)	32	Fuselage (center top L. H. & R. H.)
2	Exhaust ring	12	Trim tab (R. H. only)	22	Horizontal stabilizer	33	Fuselage (rear side panel R. H.)
3	Engine cowling	13	False rib	23	Tip (horiz. stabilizer)	34	Fuselage (ctr. side panel R. H.)
4	Baffle ring	14	Fairing (inner to outer wing)	24	Elevator	35	Fuselage (fwd. side panel R. H.)
5	Engine mount (shown)	15	Outer wing flap	25	Elevator tab	36	Fuselage (fwd. side panel L. H.)
6	Welded engine mount	16	Center wing flap	26	Tail cone	37	Fuselage (ctr. side panel L. H.)
7	Strut (landing gear)	17	Wing to fuselage fillet	26A	Glider tow	38	Main cargo door
8	Landing gear	18	Fuselage (center bottom)	27	Rudder tab	39	Bulkhead
8A	Truss (landing gear)	19	Tail wheel	28	Rudder	40	Bulkhead
9	Outer wing	20	Fuselage (rear section)	29	Tip (vertical stabilizer)	41	Bulkhead
10	Outer wing tip			30	Vertical stabilizer	42	Bulkhead
					Fairing (wrtab fwd.)	43	Navigator's dome
						44	Nose (upper)
						45	Nose (lower)
						46	Nose Cover (upper)
						47	Nose cover (lower)
						48	Center wing (complete)
						49	Center wing (from section)
						50	Center wing (rear section)

Douglas Licks U-Boats Without Bombs

By JOCK SIMPSON

Plant Superintendent, Douglas Aircraft Co., Long Beach

When ships were being torpedoed faster than they were built, hustling Douglas production lines "recruited" a winning "unarmed combat" force. . . And the supplies went through as the DC-3 flew to war.

WHEN FUTURE HISTORIANS consider World War II, they will particularly note that our "magic carpet" of aviation featured a sturdy, flexible warp without which the colorful woof and pile could not have been held together. Disclosed as a prime element in that warp will be the record of the C-47 or C-53 or R4D-1—which we will quickly recognize as one plane, not three. The old reliable Douglas DC-3.

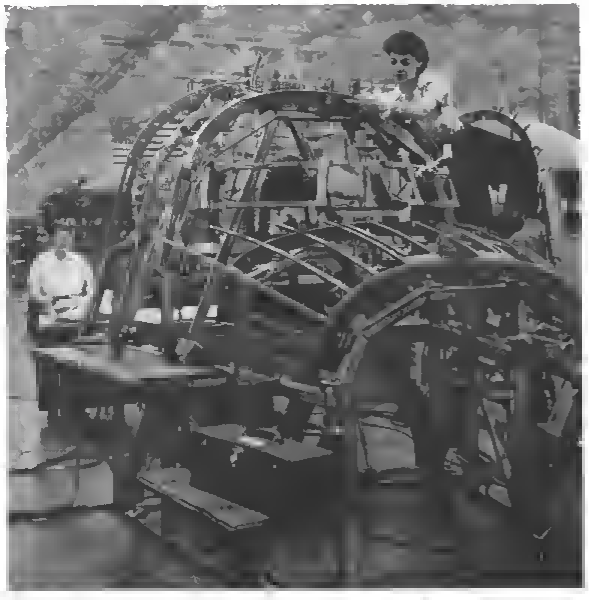
This craft became illustrious many years before its war record began, 700 DC-3's being in service prior to Pearl Harbor. In a steady, though small, stream, this transport rolled from Douglas assembly lines before Dec. 7, 1941, and thereafter it was ordered into large scale production.

By June 1, 1942, production was quadrupled . . . doubled again in the second six months of the year . . . then re-doubled in the first half of 1943. By this year's end, it is expected that the DC-3 output will attain a monthly rate bettering the number produced in fully 5½ yr. before we went to war.

So rapid was the increase in production that, by the time U-boat sinkings had set up a clamor for cargo planes, C-47's were rolling off the line faster than they could be ferried away. In a single month, production exceeded schedules by more than 60 craft, and the schedule called for several times that figure.

Affectionately known as the "Work Horse of the Air," the slightly revised DC-3 has been called "our unarmed combat plane". For through sky transport it helps the undersea wolf packs without fighting them. What's more, it—

. . . Established the Burma Road of the Air; supplied the defenders of Midway with drinking water; flew in the



Individual jigs are used for smaller assemblies.

supplies that kept the Marines fighting on Guadalcanal, made possible the campaigns against Buna and Gona; parachuted food, medicines and ammunition to "Wingate's Moh" of British guerrillas behind Jap lines in Burma; ferried from England the troops that seized airfields during the African invasion; operated daily schedules over the African express routes; towed gliders and carried paratroopers to Sicily; evacuated wounded from every front on which Allied Nations troops have fought, and performed almost countless other work-horse jobs in all climates and under every known hazard of weather and warfare.

Wherever Allied Nations outposts have been, or will be, located, there the DC-3 will be found. And when its numerous noses are counted, their total will undoubtedly arouse decided curiosity concerning the plants that produced them; hence this description of one of the Douglas C-47 assembly lines.

Comprising five major components—fuselage, empennage, center wing section, and two outer wing panels—the DC-3 assembly system incorporates a number of manufacturing concepts that may well predicate standard practice, especially on large transport craft.

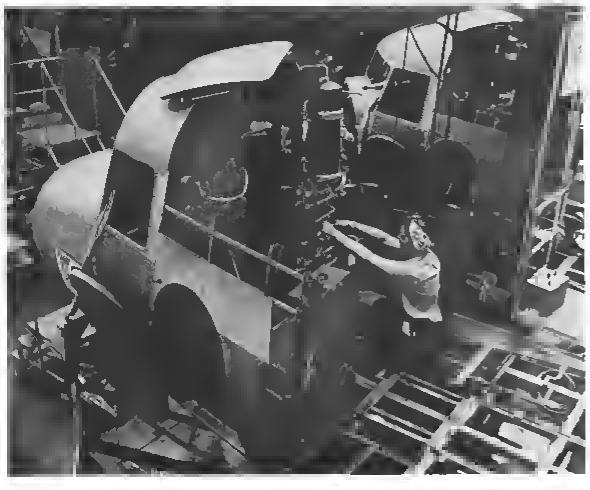
The fuselage breakdown effects a compromise between the longitudinal-panel and station-joined section methods, this compromise utilizing both methods. The tail stub is assembled from an upper and lower section and joined at a conventional station ring. Then center or main fuselage section is assembled from longitudinal top, side, and bottom panels. And the nose is joined to the fuselage along a stepped junction that is part longitudinal and part station ring.

The nose section, containing the pilot's cockpit, is composed of five separately assembled components—cockpit roof, windows, nose cone, bottom and floor, and the upper nose section. Roof, window frames, upper nose, and cone all start assembly in small jigs in sufficient volume to feed adequately nine joining jigs.

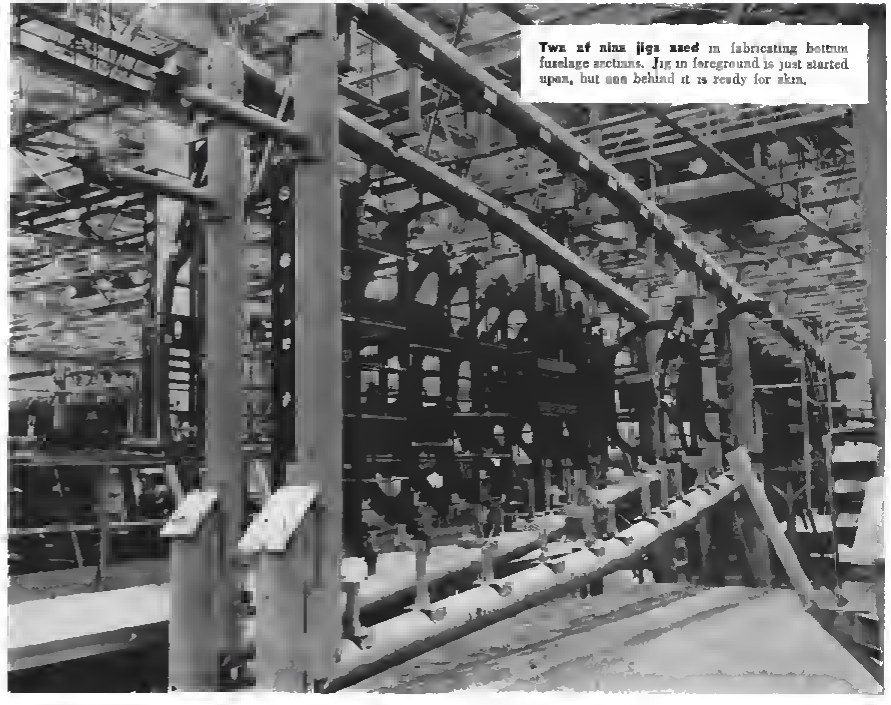
Upper nose subassembly channels and stiffeners are tied together in a small jig, then moved to the joining jig. There the window frames, cockpit roof framing, and upper nose structure are joined. Skinning begins immediately, the skins being held through pilot holes in the channels and stiffeners from which the holes for the rivets are also drilled. Drilling and riveting is done by the same crew. The upper nose section, including the pilot's cockpit enclosure, is completed, including the overhead instrument panel, before it is joined to the side and bottom assemblies.

The floor section starts in small subassembly jigs where 14 stations are tied together. These and the longerons are then joined in the first position of a nine-position, moving assembly line.

Framing is finished in the first two positions, and skinning begins in the third. There is Clecoing in the third,

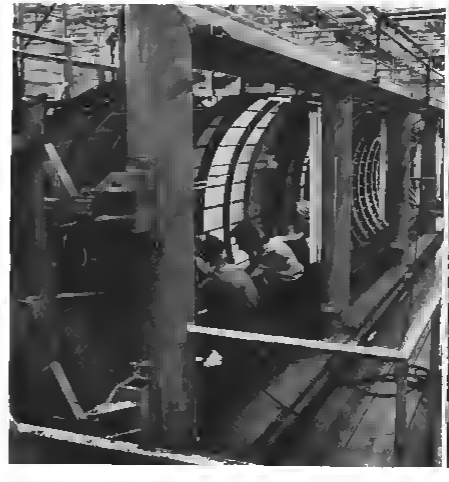


Instruments and internal equipment are installed in the pilot's section after cockpit roof is in place. These assemblies are in double lots of eight sections each.



Two of nine jigs used in fabricating bottom fuselage sections. Jig in foreground is just started upon, but one behind it is ready for skin.

Roof section jigs are a good example of careful design. Accessibility is stressed in all parts of plant.



After cutting to size, plates are fastened into large sheets by this Erco riveting machine.



fourth, and fifth positions, and riveting in the sixth to ninth positions. While on this line, the assembly is carried on its side, in vertical tubular steel jigs mounted on grooved wheels that run on inverted "V" rails. The line doubles back to the starting point, saving floor area.

On the first side of this two-leg line, framing, skinning, and cutout work is completed, with the tunnels that carry the tubing and electrical wiring being attached in the second and third positions. The carrier jigs pass between stationary work platforms of the two-level type, moving at scheduled intervals under manual power.

From this line a bottom subassembly is transferred to a dolly of a seven-station line, without tracks, where preassembled side panels, including the pilot's cockpit section are then added.

After joining bottom, side, and top sections, the assembly moves on the same carrier to the installation section. Here, on two side-by-side lines, insulation, some equipment and instruments, considerable tubing, the rudder pedals, control columns, window deicer system, and other items, are installed. Then the nose section, now complete and ready for joining to the main fuselage, is trundled to reserve storage near the fuselage joining line.

For one of its units, the fuselage proper includes the top section reaching from the ring joint at the tail stub forward to the pilot's escape hatch in the nose section. This is the longest subassembly in the airplane and has a width of about one fourth the circumference.

It is built up in a 16-position, two-leg assembly line where massive tubing jigs, one for each position, hold the assembly in a vertical position between two deck work platforms and supports for overhead electrical and air outlets.



After Erco machine work, plates are Clecoed onto fuselage frames, then riveted in place.

In the first position, all frame segments and longerons are installed, while in the second position skinning is begun and carried on through successive steps until, in the eighth position, the top section is all skinned and a major portion of the riveting has been accomplished. Then the unit crosses over and begins its return journey on the other leg of the assembly line. When it stops opposite the starting point, the completed unit is removed and placed in the main fuselage joining jig.

Another main portion of the fuselage is the bottom section, from the trailing edge of the fuselage aft to the ring joint. Its width covers about one-fourth of the circumference and contains the floor support beams and the lower portion of the large cargo door sill. It is built on a 16-position two-leg assembly line, running between single and double deck work platforms.

On the bottom section, frame segments and longerons, as well as some skins, are first Clecoed in place, after which skinning is continued in the succeeding positions. Another unique assembly procedure is seen here; for after the longerons and skins have been Clecoed in the jig, the entire assembly less the frame segments is removed in one panel to be Erco riveted. This assembly is replaced from a back log of panels that have been previously riveted.

By the eighth position, the entire bottom section is skinned and 50 per cent of the riveting has been accomplished. On the returning leg, the remaining riveting is done, leaving a position each for installation, pickup, and inspection.

There are six side panels for the fuselage—right-hand forward, center, and rear; plus left-hand forward, center, and rear. These have the cabin window, side auxiliary exits, and cargo door openings. Aft and center panels contain the fuselage-to-wing attaching points, and are made up on a 22-position, two-leg mobile line with two to five jigs for each unit. These jigs alternate right and left in order to provide a steady flow of side panels to the joining position.

Fuselage joining is accomplished in one of two jigs. Here the bottom and top sections and the side panels are joined together with the remaining ring joint segments and some internal structure. After these components are riveted firmly (but not completely) together, the fuselage is removed by an overhead crane and placed on a dolly on one of the double fuselage lines for the balance of the riveting to be accomplished in the next five positions. More the troop seat beams and the huge cargo door are fastened in place before the fuselage goes to the installation department for air ducts, wiring, floors, and everything that will not interfere with later operations.

Two-level platforms are used in final stages of fuselage construction.







Interior work is facilitated by use of portable plank platforms. **Commencing at left,** nacelles progress through various stages.

At the end of the line are four jigs where the fuselage is fastened to pads duplicating the center wing attach points while the nose is riveted in place together with internal structures such as bulkheads and floor support beams.

At this point, the fuselage has the instrument panel, rear cargo floors, control pedestal, Servo unit, battery supports, heat system, cabin windows, cockpit windows, and many minor installations, and is ready for paint shop and joining to the center wing.

Center wing sections, are assembled on moving lines of both the floor and overhead carrier types. Sub-assemblies are divided into trailing edge, main tank section, leading edge, and nacelles. The leading edge includes the secondary tank section.

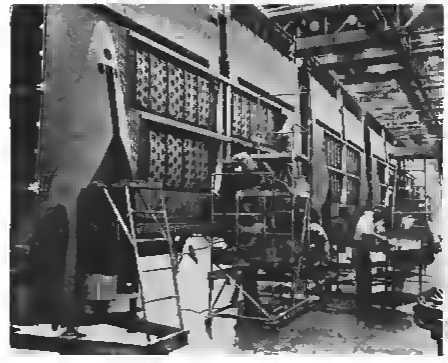
Trailing edge assembly is commenced in stationary jigs where ribs, stringers, skin panels, "Z" sections, and intercostals are riveted together. A feature of these jigs is the counterbalancing of suspended drill templates, which can be quickly lowered and Clecoed in position and just as quickly released and raised when drilling is finished.

The section is then moved to one of three main jigs where the bottom skin panel is added. After being securely fastened, the trailing edge section is attached to a floor carrier which proceeds between continuous, two-level platforms where riveting is completed and initial installations are made.

From this line the section moves to the "telescoping" position, a jig where five sections of the wing are telescoped together and tack-riveted sufficiently to permit lifting from this position to the master joining jig.

The main tank or mid-section is started in a carrier jig, held stationary while initial assembly is accomplished, then moved sidewise to the head of a manually powered line, where movement is intermittent. Bulkheads and the rear spar are joined in the stationary position. Corrugations are picked up in the third and fourth positions of the line, and skin is fitted in the fifth station.

An eight-inch, power driven bolo saw, moving along a parallel track, cuts fuel



Wing center sections are riveted into nacelles, main tanks are installed, and tubing inserted by workers at different levels.



Mounted on two dollys, center wing section will shortly be connected to fuselage.



Empennages are connected, wing fairings are in place, and fuselage is ready for wings and engine



Engines are added in line at left, mounts and parts coming from section at right

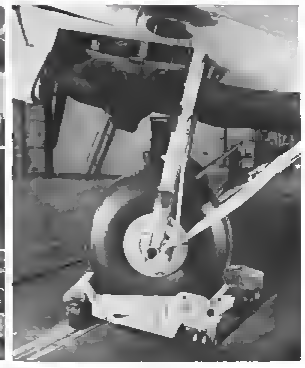


Outer wings are first Cleaned together, then riveted as they move across floor.

tank filler openings. The skin is then installed and tack-riveted before the carrier is moved to the second leg of the line on which it will return to the starting area. The bottom panel and attach angles are installed while the carrier is held in gates on the track. All other riveting and pickup work is completed in the last four stations of the line. The tank section is then transported by traveler crane to the telescoping position.

The leading edge assembly is started in one of three vertical stationary jigs where the front spar and bulkheads are





Before adding outer wings, planes are turned at 30 deg. to save space. Wheels are mounted on dollys (right) set to run at that angle in a rail.

riveted together. The component is then transferred to a carrier where it is held in a vertical position. In the first station, the pre-assembled leading edge is added. Corrugations, cantribs, skin, and front panel are then added in the next eleven stations, and finish riveting, pickup and installations are completed on the second leg of twelve stations, which double back to the starting area. A traveler crane then picks up the nose section and transports it to the telescoping position, leading edge downward, where it is lowered into the nacelles.

Nacelles are assembled in right and left halves on a "merry-go-round", in alternate jigs of a 24-station line. When tied together, the halves are moved across an aisle to an overhead suspension line, or another merry-go-round where the two halves are joined to form a right or left nacelle, with rights and lefts alternating in the carriers. When a pair of nacelles have been once around on this overhead line, they are ready for attaching to the center wing section and are transferred on dollies to the telescoping jig.

Order of assembly in the telescoping position is as follows: Nacelles are placed front end down on the floor level; leading edge is lowered into the open ends of the nacelles; next comes the main tank, then the structure is topped by the trailing edge. When the components have been tack-riveted together sufficiently to lift, the section is transferred to one of four master joining jigs. Standing on the nacelles, the section is firmly joined, with work progressing at platforms on three levels.

Removed by a traveler crane, the section enters one of two parallel 12-station completion and installation lines. Riveting is completed in the first seven stations, and installations occupy the other five.

(*Turn to page* 349)

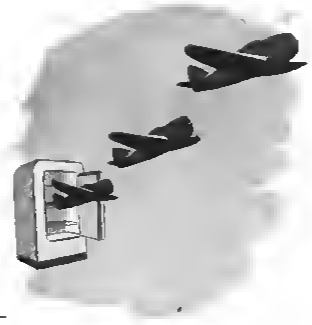
Keeping line clear. Finished planes are pushed out of shops immediately to prevent production hold up.



Refrigerators to "Thunderbolt" Wings

By GERALD ELDREDGE STEDMAN

AAF needed wings—fast. So Servel called a halt on its refrigerator production and, despite many difficulties, quickly began turning out those wings with signal man-hour economy. Here's how—



SERVEL started producing wing sections for the P-47 *Thunderbolt* in 1942. But this is the first description released of the company's wing fabrication methods, now in complete production.

The set-up is unique in (1) Plant layout, (2) tooling, (3) flow sequence of operations, (4) cycle system of assembly, and (5) trouble shooting. A resident AAF inspector, after long Army experience, described the methods as distinctly outstanding. Some part of the success is due to the ingenuity of W. R. Campbell, superintendent of the wing plant, an I.C.S. graduate in engineering with a rich automotive background and with the organization 16 yr.

Plant layout: Detailed assemblies are organized in side bays, feeding the main assembly jigs in the center. Left of center floor are such subassemblies as spar, aft, leading edge, while right of center floor are gun and ammunition bay doors, landing gear, strut and fork fairings.

Except for such hardware as wing hinges, all fabrication of parts is done in the large machining plant where women are used on turret lathes, milling machines, and drills. Forgings, castings, and extrusions are honed adjacent to assembly lines. A great variety of stampings and formings from large presses, after anodizing and painting with zinc chromate, are also brought directly to the concerned assemblies.

Aircraft wing construction was entirely foreign to previous company experience. This necessitated immediate re-schooling of engineers, tool makers, and factory personnel. Tool designers and makers were sent to Farmingdale to observe Republic methods, returned to tool up in short order. Most of the jigs and fixtures are of Servel design. Since aircraft companies often do not use the same type of drawings as straight line production companies it was apparent that the drawings provided were sometimes not adequate. People in the shop were not sufficiently familiar with aircraft drawings to assure good quality work, so the need for quick education was acute.

The company turned to isometric drawings for translating technical data to the manufacturing and inspection divisions. This lucid system of perspective has saved untold hours and has cut scrap materially in all processes.

A difficult training job was soon accomplished. Within four weeks workers were taught the technique of measuring, layout, drilling, riveting, fitting, and assembling. A distinguishing company technique has been to take as many workers as possible off the big jigs and break down the operation flow into many "sub-sub" assemblies, bringing the crew to the work, rather than the work to the crew. The sub subs flow into six subassemblies, adjacent to the center floor main assembly jigs. These are: Spar, aft, leading edge, door and fairing, landing gear and fairing, and wing tip assemblies. A considerable floor area is required for these three main subassemblies.

When the wing job first started, in order to put the skin over the frame it was necessary to have each part of the work drilled with pilot holes, after which the blank sheet metal was placed over the frame work and the holes back-drilled through the skin. These holes were then opened up part way and a third drilling operation brought each hole to the correct diameter for the rivet. Consequently the only place that specific skin would fit was on the frame from which it was back-drilled.

The so-called "aft section drill templates" were developed. The parts of the frame work are not drilled at all for skin rivet holes but instead are assembled into the frame work as was originally done. Drill templates carrying full size drill bushings are clamped into place and the holes for skin rivets are all drilled out full size in one operation. The templates are then removed from the frame work and burring, countersinking, and dimpling are completed.

In conjunction with this drill template is an assembly fixture for the skin, stringers, access door frames, clips, etc. These parts are then drilled through a drill template which matches the above mentioned frame template perfectly, including those holes drilled through the other template. After drilling, the parts are disassembled, burred, countersunk and dimpled, then reassembled and riveted.

The skin assembly then is placed over frame work for the first time and riveted in place. This method eliminates all the pilot drilling required in individual pieces as well as the necessity for increasing the holes by stages to the full diameter. It also has the advantage of making all skin assemblies and frames interchangeable thereby permitting assembling and drilling in advance of scheduled requirements.

Main assembly fixtures used in assembling the wing panel are quite elaborate and expensive to build, therefore it was necessary to reduce to a minimum the number of hours that the wing panel spends in each fixture. To accomplish this reduction in fixture time, the panel is removed from the fixture as soon as possible. In the beginning, it was then placed on special horses for minor assembly operations, although it was not possible to change its position from the horizontal which made the installation of the landing gear a relatively difficult operation.

To ease the problem of the landing gear, and also to permit more people to work on the wing by holding both sides at work level, the dolly shown herewith was designed, and it has proven to be very satisfactory.

In operation, the panel is removed from the main assembly fixture and placed in the dolly to be sent to the paint shop and sprayed. The dolly's major advantage is the fact that the plane of the wing can be changed from



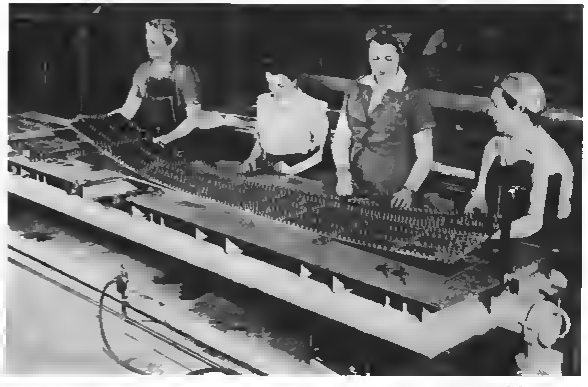
Toolmakers sweating drill bushings into templates. Accuracy is insured by using electricity for soldering. These templates are basic factors in over all production accuracy.



Spar flange is first milled to size, then bent hydraulically. Finished job must fit gauge fixture in foreground by not more than .003 in. No guesswork here.



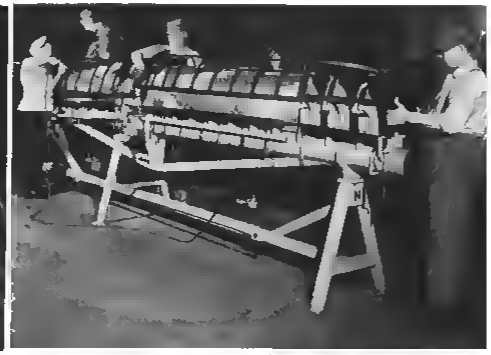
Spar assembly is drilled in this fixture by moving air drills. Bushed template insures accuracy. Note heavy tubular stand which holds work.



Main reason why holes line up. Plates are drilled under a template as a rigid fixture. Any skin will fit any frame, taking both from stock, ready for riveting.



Leading edge skin placed on assembly fixture. Nose ribs clamped in place. Skin finally will be pulled down by screw clamps at edges



Next stage of same operation. Drill template at center being placed in position. Operator (left) is drilling through template already fastened in place.

horizontal to vertical (or any position within these two extremes) for the painting operation as well as the installation of the doors, ailerons, flaps, wing tips, landing gear, etc.

Final inspection is made with wing in a horizontal position—as it would be on the plane—over a pit which permits operation of the landing gear and other hydraulic installations.

At the start, the company was able to obtain such tools as to equip each operator on the day and night shifts with the necessary drill motors, rivet guns, rivet squeezers, extension drills, air hose, etc. As the job grew and small tools became increasingly difficult to obtain (also from the point of economy) it was necessary to handle tools in such manner that two shift operations could be obtained from each individual tool. This entailed a problem in controlling tools, making sure that it was possible to go out on the job and locate any specific tool at any time.

To provide this control, the idea was adopted of painting on the boards a silhouette back of each tool, then marking the group number on the tools used by the people under one group leader. The group leader is held responsible and must, at the end of each shift, be sure that all of his tools are on his boards and in their correct places. This idea has worked very well through the entire plant.

Three principal subassemblies come to the center floor main assembly where they are cradled in the main jigs. Jig-holding plates have the same relation as the wing hinges to the actual fuselage plates, tolerances being kept within .001 in. in assembly detail.

Interesting feature of the technique is that these main assembly jigs are anchored, the working crews being brought to them rather than to have the work conveyed to the crews. This "cycle timing" is a company idea. It has resulted in far less investment in plant equipment, saving in man hours, inspection time, re-work, and repair. Final wing assembly is broken up into 23 station jobs, and each crew, especially skilled in its particular work, moves from jig to jig in the rotation of the cycle. Twenty-six main jigs are maintained, three of them reserved for any emergency that might be caused by repair or trouble among the standard jigs. At the start, the time of each station was 150 min. Improvements in planning and the growing skills of the crews has brought this down to 75 min., so a 50 percent saving in man hours has already been recorded.

Space does not permit detailing of the assembly flow of all 23 stations.



Pneumatic drills are used for light work. Operator is guided by drill fixture which prevents "creeping" of drill on material. Compressed air eliminates fire hazard.



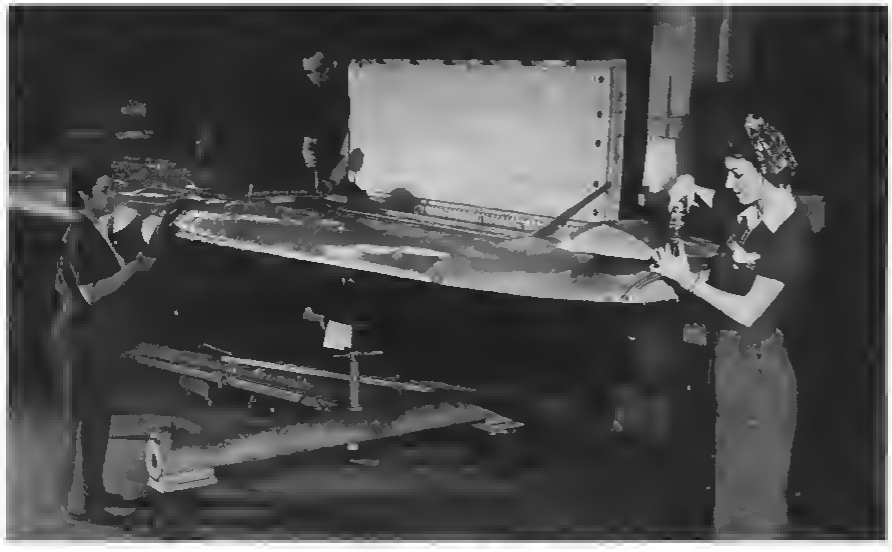
Riveting shock strut assembly. Fixture is on trunnion to allow best working position. Girl (right) is using pneumatic squeeze gun for riveting.

Ammunition bay door inner skin being riveted in place. Each panel must be inspected before next is started. Girls signal for inspector by triggering rivet gun on bench. Note that skin is tied up to prevent accidents. This job calls for considerable skill in riveting.



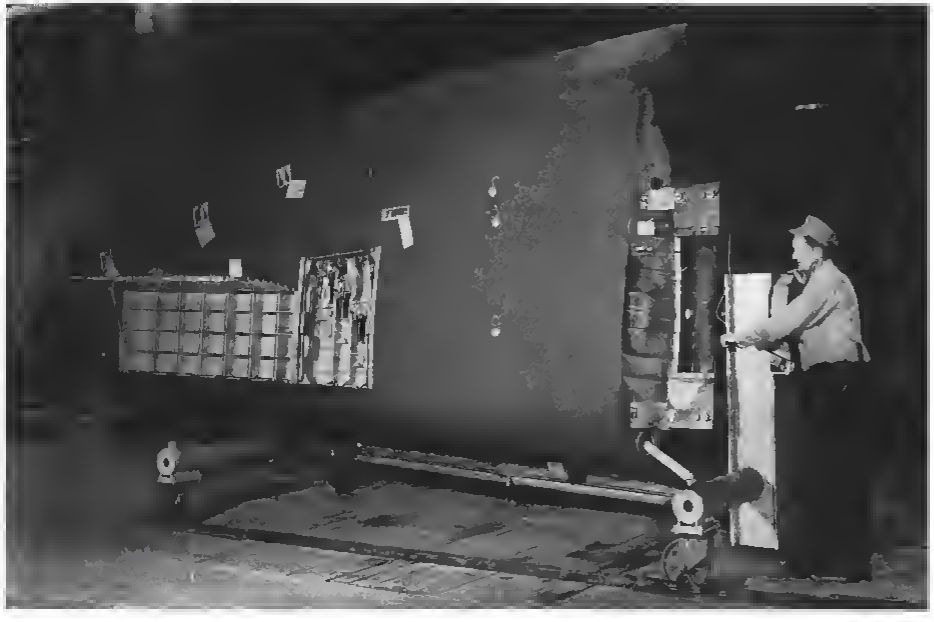


General Assembly. Additional ribs being added to leading edge, after sections and several ribs have been put in place. Note adjusting jacks under leading edge cradles.



Almost ready for spray job. In foreground wing tip is being installed while girl (left) is applying gun cover. Back center gun compartment cover is being fastened down

Final Assembly dolly is example of special fixtures designed for time saving and cost conserving. Worker (right) is rotating wing by means of crank.





Efficient handling of tough job. Fixture takes place at bottom of wing into which landing gear folds. By using trunnion mounting, work may be placed in most satisfactory position.

However, pertinent examples follow:

At Station 1, three mechanics and one helper set up the aft section, hang ribs in position, set up the leading edge by means of a locating jig, check the contour, fit, drill, and bolt ribs, fit and drill for landing gear inner door hinges, bolt and remove jig, assemble plate and fixtures to rib, drill holes to size, remove fixture, and fasten plate to rib with fasteners. This involves six parts or subassemblies, 29 tools, and 1 jig. At Station 18, a crew of three mechanics and two riveters make the electrical installation—inboard, gun bay, and outboard—involving 16 tools.

Working several crews in the same area at the same time with no overlap and moving the people rather than the work, Servel learns new ways each week to cut down time and gains increasingly from repetitive skills. The method affords a facility for "over-the-shoulder" training that makes specialists of novices in short order.

The set up is unique in the manner in which a crew of 15 mechanics in association with three staff engineers has been organized into a trouble-shoot-

(*Turn to page 346*)

Landing gear pit where wing and gear are held in approximately flight position. Here final check and inspection are made.



Ready to travel. Placing wings, ailerons, and flaps in crate for export shipment. Note angle lift at balance point



The Case for the Integral Power Plant

Part II

By SANFORD A. MOSS, Ph. D., LL. D.
Consulting Engineer, Supercharger Engineering Div., General Electric Co

Providing a critical medium through a terse caeseeeue of iedustry leadere end service men, the authar augmeete his earlier praposale for integral and staedardized aviation paver plaets.

We have considered (Part I, Sept. Aviation) our two related propositions of (1) planning aviation power plants as integral self-contained units, and (2) developing standardized mounts and plane structure supports specifically for interconnection of the two. Further, we have presented and discussed the views, concerning the integral plan, expressed by Messrs Kartveli, Ward, Ellor, and Comdr Seryngeour.

We now will treat of turbosuperchargers in the integral power plant, following which we will quote the opinions of other men who have contributed discussions. And finally, following the subheading "Standardized Power Plant Plan" and again referring to our first Figure (opposite page) we will offer a definite plan which it is hoped takes into account the various pros and cons.

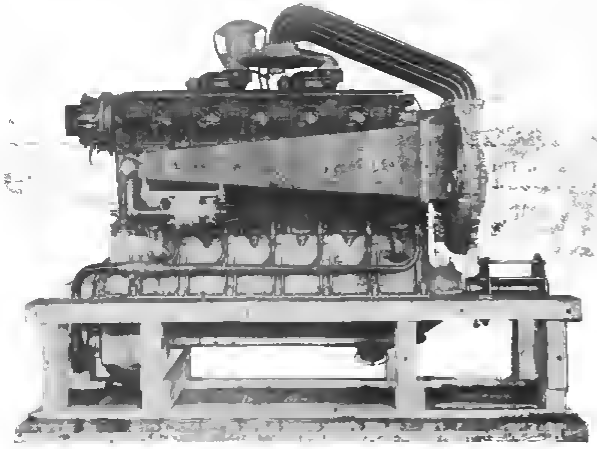


Fig. 5. First integral power plant with turbosupercharger was this 1921 *Liberty* engine. Unit included automatic control and air cooler.



Fig. 6. Lepere plane of 1922 fitted with early turbosupercharged integral plant. The flyer (left) is John Macready, altitude record holder of 1924. Beside him stands author.

Turbosuperchargers in Integral Power Plants

The writer has been intimately associated with turbosupercharger development and hopes that the entire turbosupercharger addition to the airplane engine will become a part of the integral power plant. This would include the turbosupercharger itself, the flexible joint connecting it with the exhaust manifold, the ducts with ramming intake supplying cooling air to turbosupercharger and air cooler, the supercharged air ducts from turbosupercharger to air cooler and air cooler to engine intake manifold, the air cooler, and the exhaust ducts. It is to be expected that this will be a marked improvement over many existing designs where the turbosupercharger parts are independent entities with lengthy duct connections.

Figs 5, 6, and 7 show integral power plants with turbosuperchargers, designed and constructed in cooperation with the Army Air Forces, 1921 to 1924.

Later, when turbosuperchargers came to be applied to various sorts of existing airplanes, the integral power plant plan dropped into disuse, in spite of its advantages then and now. Fig 8 is a rough sketch of an integral power plant including a turbosupercharger, as it now might be laid out.

Robert Winslow, of the Continental Aviation & Engineering Corp, states:

"Putting the turbosupercharger so near the engine would have the effect of increasing the already too high exhaust gas temperatures, so this would require that exhaust coolers be used more often."

The author realizes that this has, in the past, been a consideration. However, the ability of the turbosupercharger to take high temperatures is improving, and perhaps the point that Winslow makes will become less of an item in the future.

Continuing now to the quite different ideas on the integral plant plan expressed by the various engineers pro and con—ideas all of which seem worthwhile to include—we will first consider the opinions of C. A. Stamm, engineer of the Chrysler Corp. Incidentally, the author hastens to say that he regrets that the space available does not permit inclusion of all of the discussions which were sent to him. Paragraphs given are quoted in full, and it is thought that they present the ideas of the various gentlemen.

Says Stamm:

"The adoption of integral power plants using either engine-driven or turbosuperchargers seems very desirable from the standpoint of airplane operators, airplane builders, and engine manufacturers. Service, maintenance, and overhaul should be simplified by having all units of the power plant located in one group, detachable from the airplane as a single unit. Design and construction should be simplified and expedited by centralization of these functions with the manufacturer of an integral power plant. Over-all efficiency of the power plant should be increased because of optimum design of the component units and the connecting ducts.

"The adoption of an integral power plant unit to a large multi engined airplane should present no difficulties, but the application to a single engined airplane presents serious problems. These problems become even more severe when the trend in liquid cooled engine installations is to move the radiator away from the engine to some point in the fuselage or wing in order to decrease the cooling power losses. This is contrary to the integral power plant idea."

Pro, "Middle," and Con

opinions on this significant power plant question are offered in this timely two part series. Included are the cogent views of—

A. Kartveli, chief engineer, Republic Aviation Corp.

J. Carlton Ward, Jr., president, Fairchild Engine & Airplane Corp.

J. E. Ellor, engineer, Rolls-Royce, Ltd.

Lt. Comdr Seryngeour.

Robert Winslow, Continental Aviation & Engineering Corp.

C. A. Stamm, engineer, Chrysler Corp.

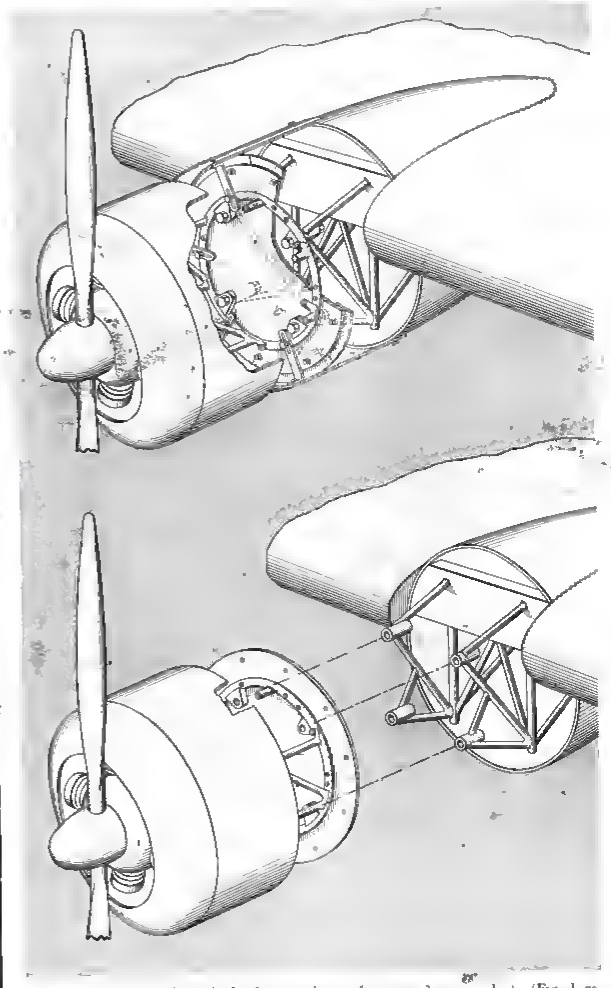
Charles W. Morris, AiResearch Mfg. Co.

Kendall Perkins, McDonnell Aircraft Corp.

Louis E. Barnes, Fisher Body Detroit Div., General Motors Corp.

Col. George C. Crom, AAF Materiel Command, Wright Field.

T. P. Hall, chief development engineer, Consolidated Vultee Aircraft Corp.



Schematic diagram of standardized mount bosses for integral power plants (Fig 1 reprinted for reference from Part I, Sept. Aviation).

Charles W. Morris, of the AiResearch Mfg. Co.:

"It was the writer's privilege to have been associated with Dr. Moss during the past three years and to have reviewed this paper in the course of its preparation. This paper is its own testimonial to the continued mental agility of its author, and this subject is quite provocative of discussion—detailed discussion.

"The basic goal of Dr. Moss' paper appears to be that complete power plant assemblies should be interchangeable between airplanes of different models and different manufacturers. In wartime, this is of tremendous importance. Whereas considerable debate will undoubtedly develop between the proponents of accessories which operate by electrical means or hydraulic means, it appears that engine mount-

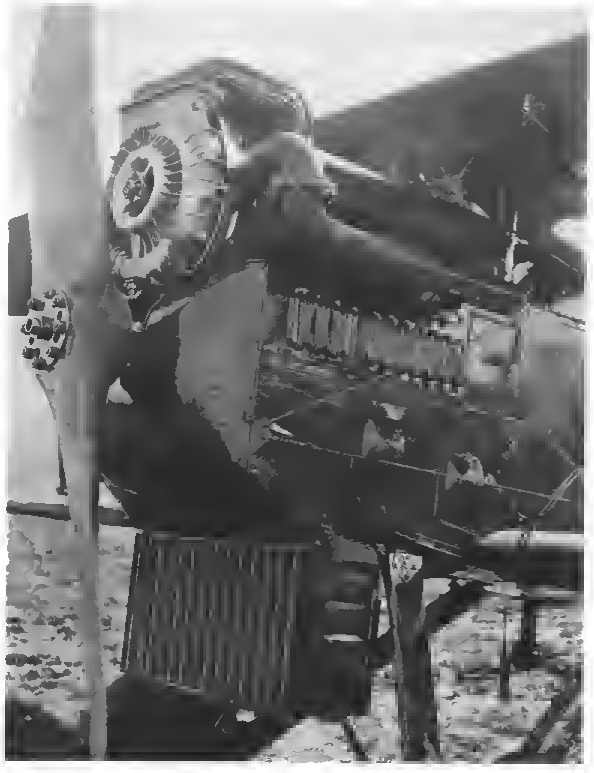


Fig. 7. Turbosupercharged integral power plant with Hispano Suiza engine on Orenco plane, about 1924.

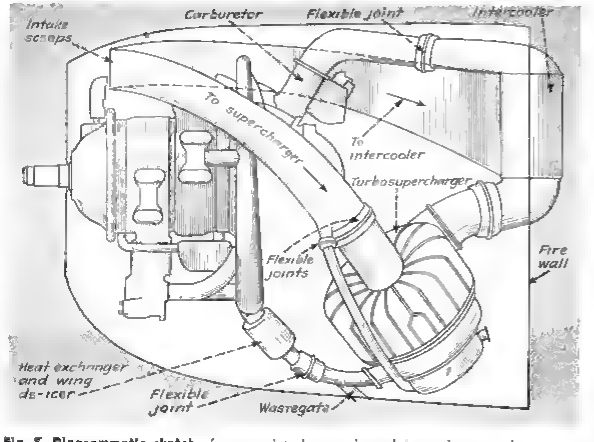


Fig. 8. Diagrammatic sketch of proposed turbosupercharged integral power plant.

ings and basic engine connections might be standardized in some fashion. This would permit ready interchangeability for emergency operation of an airplane, if necessary. Such interchangeability would be the service engineer's dream; meanwhile, the present arrangement might be considered his nightmare.

"The present DC-3 type of airplane has Wright and Pratt & Whitney engine installations which are basically interchangeable. If this interchangeability could be extended to the other models of airplanes which are powered with these same models of engines, a marked improvement of service interchangeability might result.

"There is no question of the over-all *desirability* of such a manifold interchangeability, but there is a strong question as to its *practicability*. While I disagree with Dr. Moss on some details of his proposed 'integral power plant,' his call for its reconsideration should produce some needed advancement in interchangeability. Some definite suggestions should and will be offered to the proper authorized standardizing group."

Kendall Perkins, of the McDonnell Aircraft Corp.:

"The proposition advanced by Dr. Moss, although frequently advanced, has never taken root in this country.

"First it should be remembered that in thinking of the national production problem there is not one engine to be considered, but many. There are perhaps two dozen engines of various power and type being built in this country after several years during which serious attempts have been made to eliminate unnecessary types. A few of these, such as the P & W R-1830 and the Wright R-1820, are interchangeable at least to the extent that one may be substituted for the other in a given airplane without major effect on performance. Even in such cases, however, it has not proved feasible to discontinue production of a recognized engine in the interest of standardization and there seems no hope of materially reducing this number.

"If we then accept the inevitable necessity for using a number of different engines of various power and type we can then say: 'Let us at least have a standardized integral unit to go with each engine model.' However, we are immediately faced with more variables. We find that one airplane can best perform its function when equipped with a turbosupercharger. Another does best with a two-speed gear-driven supercharger. The differences required in the power plant for these and other similar variables are, as it works out practically, enough to require a basically different arrangement in each case.

(*Turn to page 276*)



We know about the playing fields of Eton... but what about Public School No. 9? ☆ ☆ ☆ Skinny Wolenski sold papers after school... but found time to pitch on the ball team. A grenade he tossed square into a pillbox saved a day at Messina. ☆ ☆ ☆ Then take Fatty Foster... from swank Murray Hill. He was third-string center on the football squad, but a first-string bombardier... His sister, Mary Jane... is a prisoner in Japan... but some of the lads who made it from Bataan, have trouble with their voices when they talk of her job with the wounded! ☆ ☆ ☆ And smart aleck Manny Cohen... His score in a Grumman at Guadalcanal made good a lot of adolescent bragging. ☆ ☆ ☆ Tony Mourillo was the leader of our gang—and always managed to take the rap... what he took over the Ruhr from some "Mess-up one-o-nines" never changed the grin on his face... his chore at the tail gun-turret of a Fortress, got 'em back at the price of one life... instead of nine ☆ ☆ ☆ Timid Arch Percival got the Navy Cross (posthumously we're sorry to say). It had to do with the blazing oil and a job of saving his crew. ☆ ☆ ☆

So goes the record on... and on. For high traditions are life lines on which posterity's pattern is built... and America's part in this global crusade simply emphasizes once again, that our participation on the far-flung battle front is... "of the people, by the people, and for the people."

We're modestly proud, that at this moment, Hydraulic Systems and Electronic Units which are vital components of our Air Force planes are being supplied in ever increasing numbers to our Government.

Joseph E. Wachter
PRESIDENT

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Design Approach For Long Range Aircraft

Part II

By ROBERT V. BONAME, *American Export Airlines*

Actual examples are cited by the author to demonstrate application of principles in the development of flying boats for distance runs.

HAVING CONSIDERED the formulas and theory, let us now emphasize that our present example has no pretention whatever of leading to a conclusion of absolute character or indicating any future trends or possibilities. Based on numerical values which have been commonly used in aircraft technique for the last few years, its main purpose consists only in illustrating the practical application of the foregoing (Part I) to any particular concrete case.

In this instance we shall select the problem of a direct non-stop trans-Atlantic crossing under the most adverse conditions which can be considered, that is, in the direction from Europe to the U. S. This assignment was submitted to French aircraft manufacturers, first in 1934 for 45-ton flying boats, then in 1938 for 70-ton craft, destined for a non-stop flight of 3,700 statute miles against a constant headwind of 37 mph.

We will furthermore assume that the economic side of the question as to the quantity and quality of the market and frequency of the services—as well as the considerations pertaining to the operational standard of safety and comfort, and the possibilities of the technique of the moment—have led us to accept for our flying boat a total gross weight of approximately 150,000 lb.

Thus, as the fundamental basis of the problem, and using the same notation as above, we have

$R_t = 3{,}700$ mi. $V = 37$ mph. $W = 150{,}000$ lb.

We will also add, as secondary requirements, that—

a. the operator does not intend to operate at an altitude over 10,000 ft., which would normally require pressurizing the passenger cabin;

b. the plane would be equipped with at least four independent power plants;

c. the rate of climb with 70 percent of the total rated hhp would still be at least 300 fpm, with the plane at full gross weight and one engine stopped at the end of the takeoff run; and

d. that the aircraft be calculated to land at a speed not in excess of 72 mph when her full gross weight has been reduced by one half the normal total load of fuel.

As for data furnished by experience, we shall take as conservative estimates: .80 for the typical propeller efficiency, .42 for the typical specific fuel consumption, and 2.6 for the maximum value of the lift coefficient, considering the properties of modern high lift devices together with the Reynolds number effect relative to the size of the machine.

Solving the problem within the reasonable limits of current technique, we shall assign our first arbitrary values to the total fuel load as follows:

W_f = 30,000, 40,000, 50,000, and 60,000 lb. to the minimum parasite drag coefficient:

C_{p_o} = .015, .020, .025 and .030.

From Equation 2 we then obtain for values of the wing area and corresponding wing loading, respectively: 3,900 sq. ft. and 38.5; 3,750 sq. ft. and 40; 3,600 sq. ft. and 41.5; 3,500 sq. ft. and 43.

Solving Equations 1 and 3 (Part I) for obtaining the proper values of aspect ratio R and average speed V_a will require a more special method.

Indeed for any numerical value of C_{p_o}, Equation 3 gives V_a as a function of R, expressed by—

$$\frac{K}{\sqrt[4]{R}} \quad \text{or} \quad \frac{K}{x} \text{ if we designate } \sqrt[4]{R} \text{ by } x,$$

K being a numerical constant.

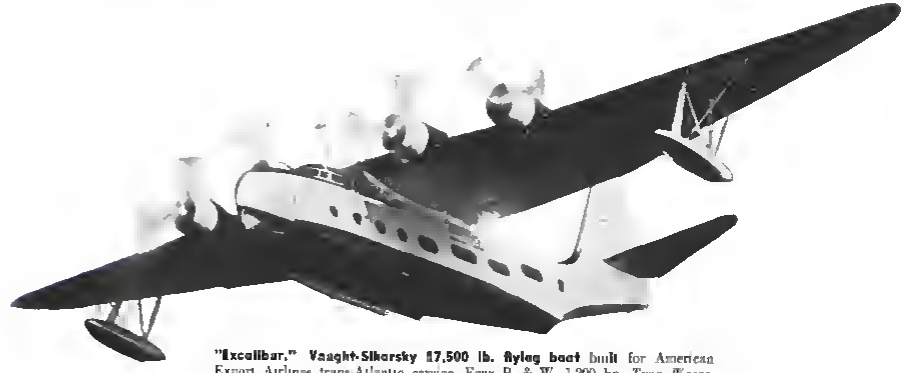
Expressing V_a in terms of x in Equation 1, where

$$\log_e \frac{W}{(W - W_f)}$$

has been designated by A, we then obtain a third degree equation* of the form

$$x^3 (A\,K \times 1{,}420 - 52{,}500\,Ax) - 3\,700\,\mathrm{K}\sqrt{C_{p_o}} = 0$$

Such an equation can be solved graphically, considering, as in Fig. 4, (Part I), the points where the different lines $3{,}700.K.\sqrt{C_{p_o}}$ intersect the curves



"Excalibur," Vaught-Sikorsky 17,500 lb. flying boat built for American Export Airlines trans-Atlantic service. Four P. & W. 1,200 hp. *Twin Wasps*. Max. speed 225 mph.; cruises at 175 mph., range at 150 mph. 3,800 mi.; initial climb rate, 900 fpm.

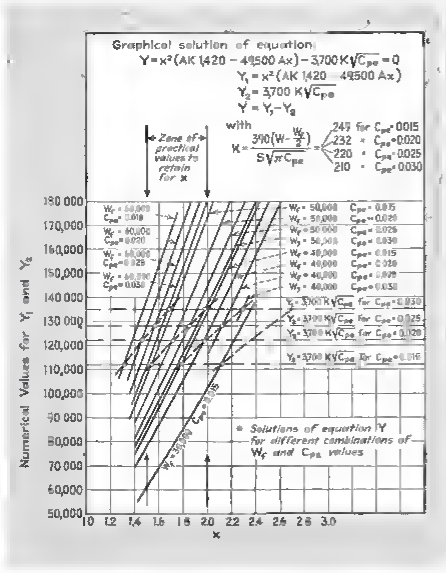


Fig. 7. Solutions of Equation Y for different combinations of W_f and C_{po}

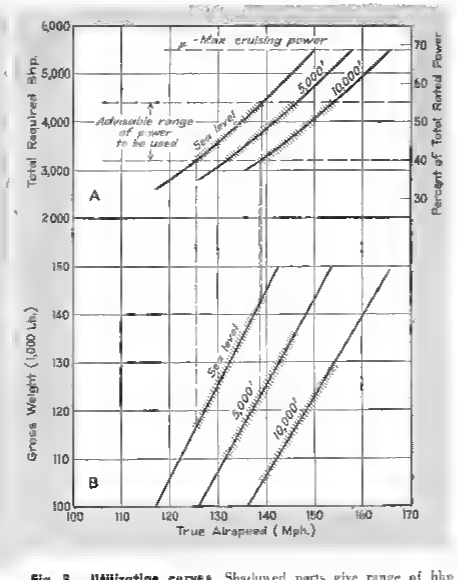


Fig. 8 Utilization curves. Shadowed parts give range of bhp recommended. Section A. Variation of power required and per centage of rated power used vs. true air speed at different altitudes. Section B. Variation of optimum cruising speed vs. gross weight

TABLE II

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
W_f	S sq. ft.	W/S	$C_{po} = .015$			$C_{po} = .020$			$C_{po} = .025$			$C_{po} = .030$		
			V_o	R_o	bhp	V_o	R_o	bhp	V_o	R_o	bhp	V_o	R_o	bhp
30,000	3,900	38.5	No Sol.	No Sol.		No Sol.	No Sol.		No Sol.	No Sol.		No Sol.	No Sol.	
40,000	3,750	40	140	6.8	5,300	118	15.4	4,250	No Sol.	No Sol.		No Sol.	No Sol.	
50,000	3,640	41.8	162	5.6	7,400	135	6.7	6,100	118	11.6	5,110	105	18.3	4,400
60,000	3,500	43	No Sol.	No Sol.		158	4.5	9,500	140	6.1	8,200	124	8.16	6,800

TABLE III

1	2	3	4	5	6	7	8
Wing Area S	Tail Area $.25S$	Number and bhp of Engines	Wing Drag Coef.	Tail Drag at 100 mph.	Hull Drag at 100 mph	Engine Nacelles Drag at 100 mph	Minimum C_{po} as equal to $\frac{5}{25} + \frac{6}{38} + \frac{7}{38 \times S}$
3,500 sq. ft.	880 sq. ft.	4 × 2,000 6 × 1,500	.0080	350	1,060	310 250	.0271 .0276
3,640	910	4 × 1,100 4 × 1,500 4 × 2,000	.0080	364	1,060	184 230 310	.025 .0257 .0265
3,780	940	4 × 1,100 4 × 1,500	.0080	375	1,060	184 230	.0247 .0254

TABLE IV

Wing Area S (sq. ft.)	C_{po} as Given by Diag.	R_o as Given by Drag	Wing Weight in lb. as Given by Formula	Tail Weight $44S$	Bhp. TR as Given by Drag	Number of Engines n	Weight of Power Plant Installation 1.3 bhp + $n \times 1000$	W_f	Total $W_e + W_f$
3,500	.0277	7.1	17,000	1,540	9,120	8	17,800	60,000	96,340
3,570	.0265	9.5	24,640	1,580	7,800	4	14,900	55,000	95,120
3,640	.0260	12.5	31,780	1,600	6,700	4	12,700	50,000	96,080
3,685	.0254	15.8	41,800	1,620	5,800	4	11,400	45,000	100,120

x^2 (AK 1,420 − 52,500 Ax) drawn vs. x for a same value of K and C_{po}.

A certain number of those lines and curves have been drawn in Fig. 7 for the conditions outlined below. Although only values of x comprised between

$$\sqrt[3]{9} = 1.5 \text{ and } \sqrt{11} = 2$$

should be retained, since they correspond, respectively, to the lowest and highest values, 6 and 16, which could be reasonably considered for R_o, we will nevertheless use the solutions of x found somewhat above or under these limits as means of extrapolation in establishing the curves which we will draw later. Here are the four possible conditions:

a $C_{po} = .015$, $K = 249$, $A = f(W_f)$ successively, for W_f = 30,000, 40,000, 50,000, and 60,000.

There is no solution within the considered limits, since R_o would have to be well over 16.

*Note: Equation 1 becomes:

$$3{,}700 \times \frac{V_o}{V_o - 37} = 863.5 \sqrt{\frac{\pi R_o}{4 C_{po}}} \times \frac{.80}{.42} \times A$$

or: $$3{,}700\, V_o = 1{,}420\,(V_o - 37) \times \sqrt{\frac{R_o}{C_{po}}} \times A, \text{ as } V_o = \frac{K}{x}$$

$$3{,}700\, K \times \sqrt{C_{po}} = 1{,}420\, A K x^2 - 52{,}500\, A K x^3$$

which may be written:

$$x^2\,(AK\,1{,}420 - 52{,}500\,Ax) - 3{,}700\,Kx\sqrt{C_{po}} = 0$$

b $C_{po} = .020$ $K = 232$ and the same values for A as above. The three following solutions will be considered:

$R_o = 4.55$ with $V_o = 158$ and $W_f = 60{,}000$

$R_o = 8.7$ with $V_o = 135$ and $W_f = 50{,}000$

$R_o = 18.4$ with $V_o = 118$ and $W_f = 40{,}000$

c $C_{po} = .025$ $K = 220$ and same values for A as above, two solutions can be considered:

$R_o = 5.6$ with $V_o = 162$ and $W_f = 50{,}000$

$R_o = 11.6$ with $V_o = 118$ and $W_f = 40{,}000$

d $C_{po} = .030$ $K = 210$ and same values for A as above. There are two solutions to consider:

$R_o = 8.15$ with $V_o = 124$ and $W_f = 60{,}000$

$R_o = 15.3$ with $V_o = 106$ and $W_f = 50{,}000$

These results have been summarized in Table II and by the curves drawn in Figs. 1, 2, and 3 (Part I).

Using the above values in Equation 4, we obtain without any difficulty the total rated power as imposed in each case by the climbing condition with only 70 percent of the power disposable. The values thus obtained have been listed in columns 6, 9, 12 and 15 (Table I) and used in Fig. 3 (Part I).

Values of C_{po} which can actually be obtained for different combinations of power with the considered wing area have then been computed on the following basis:

The wing airfoil has been assumed the same for each case and, according to the characteristics of the well-known modern airfoil, its absolute minimum drag coefficient has been taken as equal to .0080.

The tail area has been estimated equal to .25 percent of the wing area S, and its minimum drag at 100 mph., based on a unit drag of 40 lb. per sq. ft., will be equal to $.25 \times S \times 40 = S/10$ lb.

The hull, remaining the same for any combination of wing and power arrangement, has been estimated to have a frontal area of 280 sq. ft. and, according to Diehl's data, its minimum drag at 100 mph. has been taken equal, approximately, to $280 \times 3.8 = 1{,}060$ lb.

For drag of the engine nacelles, we have assumed that a total horsepower in excess of 8,000 hp. will require six engines, instead of the minimum of four, and that the corresponding drag will be given by the following Diehl empirical formula: $.0138 \times d^2 \times n$ where n is the number of nacelles and d the over-all diameter in inches taken as: 50 in. for

(*Turn to page 326*)

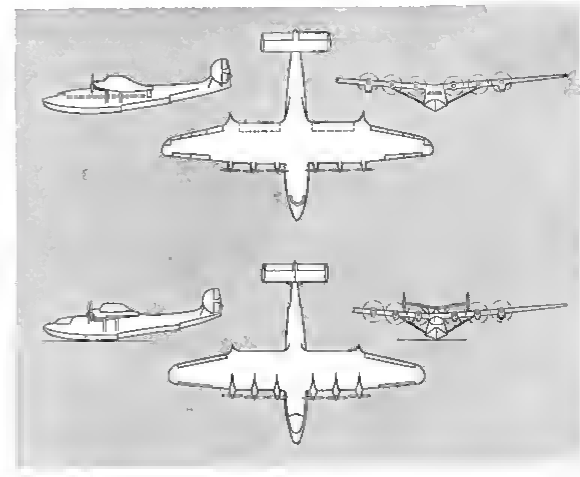


Fig. 9. Tap Six-engine 46-ton French trans-Atlantic flying boat *Potez Cams*. Gross wt. 95,000 lb., wt. empty, 51,000 lb.; six 1,100 hp. liquid-cooled engines; power loading, 14.4 lb./hp., wing loading, 33 lb./sq. ft. range against 37 mph. headwind, 3,370 mi., cruising speed 180 mph. Bottom: Scale model of above boat, scale 1:2.6. Specifications are, gross wt. 5,000 lb., six-40 hp. engines; power loading, 20.5, wing loading, 12.

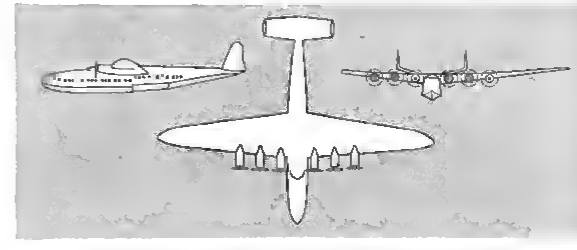


Fig. 10 "Latecoere" French trans-Atlantic flying boat. Specifications are: gross wt. 150,000 lb.; empty, 82,000 lb., six 1,600 hp. engines, power loading, 15.6, wing loading, 40; range, 700 mi. against 37 mph. headwind, cruises at 185 mph.

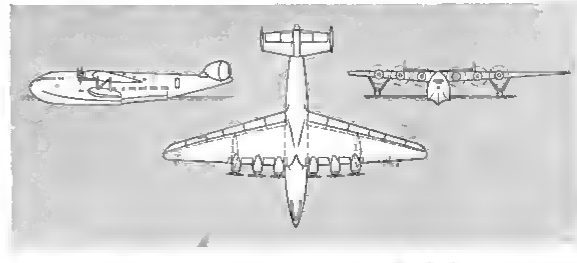


Fig. 11. SE209. French trans-Atlantic flying boat. Specifications: gross wt. 150,000 lb., empty, 80,000 lb., six 1,600 hp. engines, power loading, 15.6, wing loading, 41; range, 3,700 mi. against 37 mph. headwind, cruises at 185 mph.

Super-Aluminum Alloys For Aircraft Structures

Part III

By KENNETH R. JACKMAN,

Chief Test Engineer, Engineering Test Laboratories, San Diego Div., Consolidated Vultee Aircraft Corp.

Presenting results of comprehensive studies on corrosion resistance of new artificially aged aluminum alloys and, in concluding the series, citing weight savings possible to aircraft going on design boards.

MUCH HAS BEEN SAID and written about the dangers of corrosion on artificially aged aluminum alloy, and today, in consideration of a superior material for "tomorrow's" plane, one can look back upon these early fears of the aircraft industry with a smile. To be sure, 24ST alloy, when aged and subjected to salt spray, will show some characteristic intercrystalline separation at the grain boundaries, but today there is the 24S1 Alclad material, with its 5-percent-thick pure aluminum sheathing on each surface, which does not appear to be sensitive to corrosion, except possibly at local cut edges. To prevent corrosion, these raw edges can be protected adequately by anodization, or by prime and paint.

A comprehensive study has been made by the CVAC test laboratories at San Diego of the effects of aging on the corrosion resistance of both clad and unclad 24S aluminum alloy. These findings have been substantiated by the Aluminum Research Laboratories, Vega Aircraft, and others.

Although at present interest is confined primarily to 24S Alclad with 10 percent protection, many unclad 24S specimens have been tested, to study the corrosion tendencies of the core of the 24S Alclad sheets. It is realized that the electrolytic protective feature of Alclad sheet is probably somewhat lessened by artificial aging. However, the covering action of the pure aluminum surfaces is still fully effective, and tests made to date on both aged and unaged 24S Alclad sheets show negligible differences in corrosion resistance.

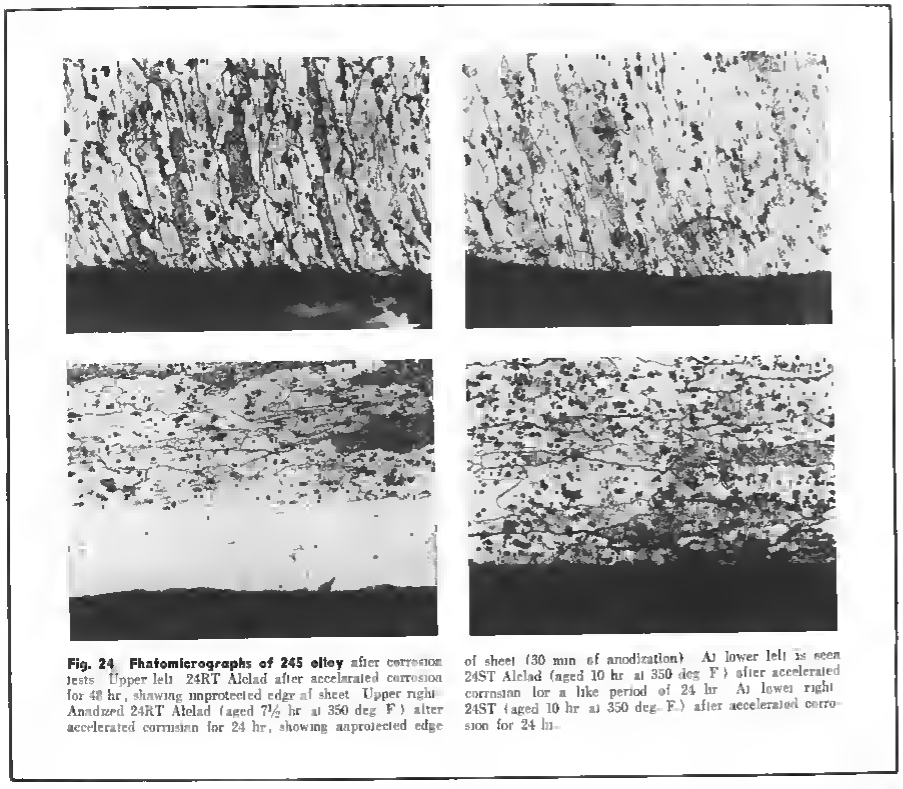
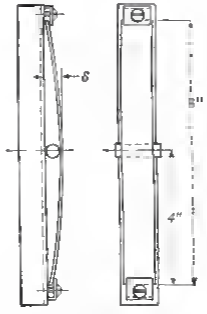


Fig. 24—Photomicrographs of 24S alloy after corrosion tests. Upper left: 24RT Alclad after accelerated corrosion for 48 hr., showing unprotected edge of sheet. Upper right: Annealed 24RT Alclad (aged 7½ hr. at 350 deg. F.) after accelerated corrosion for 24 hr., showing unprotected edge of sheet (30 min. of anodization). At lower left is seen 24ST Alclad (aged 10 hr. at 350 deg. F.) after accelerated corrosion for a like period of 24 hr. At lower right: 24ST (aged 10 hr. at 350 deg. F.) after accelerated corrosion for 24 hr.



Profile and plan view sketches showing components of stress corrosion test jig illustrated in Fig. 25.

Nock and Mears[10] of the Aluminum Research Laboratories, have found that resistance to corrosion of cold-water quenched 24ST or 24SRT first decreases sharply after initial periods of artificial aging, then increases with longer aging periods. When the material has been aged to obtain maximum strengths, resistance to corrosion is equal to that of cold water quenched, room-temperature aged 24ST. Indications are that resistance to corrosion of 24ST8 Alclad is similar to, but somewhat less than, that of cold-water quenched 24ST Alclad.

The inferior resistance to corrosion of 24ST8 Alclad can be attributed, according to the Alcoa findings to the smaller potential difference between the coating and the core for artificially aged material. Alcoa has also found that resistance to corrosion of 24ST extrusions, aged under optimum conditions, appears definitely to be superior to the resistance of room-temperature aged 24ST extrusions. However, CVAC has found, from somewhat meager tests, that slight intergranular corrosion is to be expected in aged 24S extrusions unless a surface finish is applied.

Fig. 24 shows four typical photomicrographs made in the San Diego test laboratories of aged and stretched 24S aluminum alloys after corrosion tests. The test specimens used in these CVAC investigations consisted of standard ½ in. wide tensile coupons cut from 0.091 in. and 0.187 in. 24SO and 24SO Alclad sheet. The respective coupons were

TABLE IV—CORROSION TESTS ON 24S ALUMINUM ALLOY SHEET

A. Tensile Results From 0.091 in. 24S Alclad Sheet Aged at 350° F. for 7½ hr.

Spec. No.	Anodizing Time (min.)	Salt Spray (hr.)	Accel. Corrosion (hr.)	24SO Heat Treated: Stress—psi. Yield	24SO Heat Treated: Stress—psi. Ultimate	24SO Heat Treated: Elong. % in 2 in.	24SO H T. Aged at 350°F 7½ hr: Stress—psi. Yield	24SO H T. Aged at 350°F 7½ hr: Stress—psi. Ultimate	24SO H T. Aged at 350°F 7½ hr: Elong. % in 2 in.
Unaged Control Coupons									
1	0	0	0	42 000	63 500	17 0	54 000	64 800	13 5
2	0	500	0	40 900	62 300	17 0	53 500	64 000	11 5
3	0	0	48	41 500	62 400	14 0	55 000	65 000	12 5
4	30	0	0	41 300	62 800	18 0	54 500	65 100	13 5
5	30	500	0	41 900	63 500	15 5	52 200	64 100	12 0
6	30	0	48	40 300	62 300	18 0	53 000	65 000	14 5
Aged Coupons (350° F. for 7½ hr.)									
7	0	0	0	43 500	62 000	15 0	64 000	68 800	7 5
8	0	500	0	43 300	59 600	8 0	65 000	67 000	4 5
9	0	0	48	42 800	57 800	8 0	64 000	68 100	8 0
10	30	0	0	44 400	66 000	16 0	65 500	69 700	8 5
11	30	500	0	43 900	61 800	14 0	64 500	67 800	8 0
12	30	0	24	42 700	62 500	18 0	65 200	69 800	8 5

B. Tensile Results From 0.091 in. 24S Alclad Sheet Aged at 350° F. for 10 hr.

Spec.	Type of Corrosive Medium	24S-T (As Rec'd): Stress—psi. Yield	24S-T (As Rec'd): Stress—psi. Ultimate	24S-T (As Rec'd): Elong. % in 2 in.	Aged 10 Hrs. at 350°F: Stress—psi. Yield	Aged 10 Hrs. at 350°F: Stress—psi. Ultimate	Aged 10 Hrs. at 350°F: Elong., % in 2 in.
1	None	55 700	71 800	15 0	70 800	74 000	3 0
2	None	53 800	69 600	17 0	70 400	74 600	3 0
3	Salt Spray (250 hr. at 95° F. in 20% NaCl)	54 000	60 600*	4 5*	66 000	71 100	3 0
4		54 000	69 100	10 5	68 000	70 100	2 0
5	Accelerated (24 hr. at 80° F. in NaCl-H_2O_2Sol.)	53 000	62 600	6 0	67 700	69 000	4 0
6		54 700	66 500	8 5	67 400	68 700	3 0

* Probably low test results.

TABLE V—MECHANICAL PROPERTIES OF 24S ALUMINUM ALLOYS

Typical and Minimum Values for .020 in. to .128 in. Sheet

Values	Symbol	Treatment: Source	Treatment: or Stretch %	Tension: Aging °F	Tension: Aging Hr	Tension: Yld.* F_{ty}	Tension: Ult.* F_{tu}	Tension: Elong. % in 2 in.	Compr. Yield* F_{cy}	Ratio F_{cy}/F_{ty}	Shear Ult.* F_{su}	% Property Change: F_{ty}	% Property Change: F_{tu}	Data Source
	NON-ALCLAD													
Max.	24SO	As Rec'd	0	0	0	—	35	18	—	—	—			Alcoa, 1942 Handbook Table 17
Min.	24S1	As Rec'd	1	0	0	40	62	19	40	0 65	37			
	24ST-RT	As Rec'd	8½	0	0	50	68	12	60	0 74	39			
	24SO	As Rec'd	0	0	0	18	28	20		0 57	18			
	24ST	As Rec'd	1	0	0	47	66	19	43	0 68	41 —	0	0	
Typ.	24ST	24SO-H T	0	0	0	43	67	18	41	0 65	40	−8	−4	Alcoa Table 6
	24RT	24SO H T	3½	0	0	53	68	19	48	0 78	42	+13	+4	
	24SRT	As Rec'd	8½	0	0	53	70	13	50	0 76	42	+17	+16	
	ALCLAD (10%)													
Max.	24SO Ale.	As Rec'd	0	0	0	—	33	18	—	—	—			Alcoa Table 17
Min.	24ST Ale.	As Rec'd	1	0	0	37	66	15	37	0 66	34			
	24SRT Ale.	As Rec'd	8½	0	0	46	62	10	46	0 74	35			
	24SO Ale.	As Rec'd	0	0	0	14	26	18		0 54	16			
	24ST Ale.	As Rec'd	1	0	0	45	63	18	42	0 71	40	0	0	
Typ.	24ST Ale.	24SO H T	0	0	0	41	60	18	38	0 68	39	−8	−7	Alcoa Table 6
	24RT Ale.	24SO H T	3½	0	0	51	64	14	44	0 80	41	+13	+5	
	24SRT Ale.	As Rec'd	8½	0	0	54	68	11	48	0 86	41	+20	+10	
	24S-T8R0 Ale.	24SO H T	0	365	8½	48	62	10	48	0 74	39	+2	+14	
	24S-T8 Ale.	24S1 As Rec'd	1	365	8½	57	65	8	57	0 87	40	+27	+36	CVAC Report ZM-028
Min.	24S-T8R 35 Ale.	24-RT	2½	365	6½	63	67	6	64	0 94	42	+40	+52	
	24S-R78 Ale.	24S-RT	8½	365	7½	66	70	5	66	0 94	42	+47	+58	

*Stresses given in 1 000 psi.

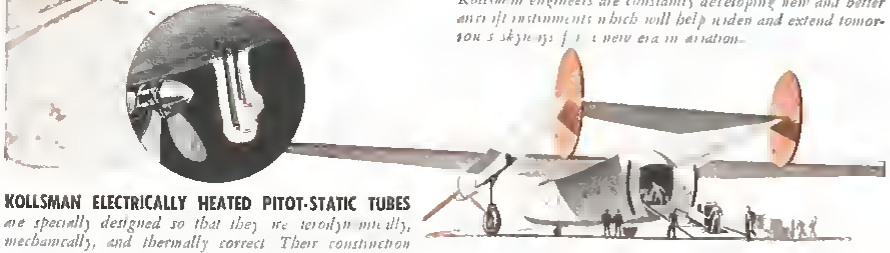
**Pre-stretch given in percent permanent set. 1% and 8½% are approximations of pre-stretch equivalent to cold-work in the as-received condition.

"Sampling" the breeze

AVIATION experts once opposed enclosing the pilot in a cockpit, claiming he needed to feel the rush of air upon face and body in order to tell what his plane was doing. Today the pitot-static tube protruding from wing or fuselage does this job with a lot more accuracy and dependability, transmitting dynamic and static air pressures to the instrument panel for the operation of the air speed indicator, the rate-of-climb indicator and the altimeter. Its rain- and-ice-proof construction assure accurate and continuous functioning under all weather conditions. The design and construction of Kollsman pitot-static tubes are representative of the skill that goes into all Kollsman precision aircraft instruments, long supplied for military and civil aviation.



THE CARGO PLANES OF TOMORROW *will differ in many respects depending upon the service they are to perform. But there is one thing they will all have in common: instruments will play a tremendous part in their scope and usefulness. Kollsman engineers are constantly developing new and better aircraft instruments which will help widen and extend tomorrow's skyways for a new era in aviation.*



KOLLSMAN ELECTRICALLY HEATED PITOT-STATIC TUBES *are specially designed so that they are aerodynamically, mechanically, and thermally correct. Their construction ensures the faithful transmission of pitot and static pressures at all speeds and through all angles of pitch and yaw up to 16 degrees.*

KOLLSMAN AIRCRAFT INSTRUMENTS

PRODUCT OF

SQUARE D COMPANY

ELMHURST, NEW YORK — GLENDALE, CALIFORNIA

TABLE VI—PLATE-STRINGER TESTS

24ST8 Plate—24STSR3.5 Trapezoidal Hats

Spec. No.	Gauge in.	Area sq in	PLATE: Tension 24S-T Yld psi	24S-T Ult psi	24S-T Elong in 2 in	24S-T8 Yld psi	24S-T8 Ult. psi	24S-T8 Elong. in 2 in	Compression 24S-T Yld psi	Compression 24S-T8 Yld psi
1	0 125	2 53	49 260	64 850	16 5	63 000	68 050	7 5	40 700	63 650
2	0 125	2 52	48 280	64 850	18 5	63 000	68 050	7 5	40 700	63 650
3	0 091	1 82	48 700	62 450	15 5	60 850	65 800	5 5	40 350	61 600
4	0 072	1 45	48 350	63 200	18 5	60 650	65 000	5 5	40 780	61 700

Stringers (Rolled Hats, 1¾ in. Deep x 4⅛ in. Wide)

Spec. No	No	Gauge in	Area (All Hats) sq in	Physical Properties: Tension 24RT Yld psi	24RT Ult psi	24RT Elong. in 2 in.	24S-TSR 3.5 Yld psi	24S-TSR 3.5 Ult psi	24S-TSR 3.5 Elong. in 2 in.	Compression 24RT Yld. psi.	Compression 24S-TSR 3.5 Yld psi
1	3	0 091	1 71	52 150	63 400	15 5	68 900	71 450	8 0	45 500	69 850
2	3	0 091	1 65	48 350	67 150	15 0	70 600	73 400	7 0	47 200	72 000
3	3	0 091	1 65	53 800	67 700	15 5	69 950	72 650	10 0	46 250	70 750
4	3	0 091	1 67	47 100	65 250	14 5	67 780	70 900	7 5	45 200	67 750

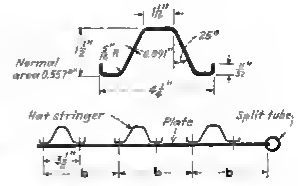
Specimen (Plate-Stringer Combination)

Spec. No	Length in	Width in	b (Stringer Spacing) in	Rivets: Type	Rivets: Spacing in	Area sq in	Test Load lb	Unit Stress psi
1	31 06	30 28	6–5/16	AN426-AD8	1–1/4	4 23	203 900	48 200
2	42 53	30 28	6–5/16	AN426-AD5	1 3/4	4 17	165 300	39 600
3	31 06	30 28	6–5/16	AN426-AD8	1 3/4	3 47	148 500	42 800
4	30 81	30 28	6–5/16	AN426-AD6	1	3 13	130 000	41 500

cut from a single sheet of each type and gage to make the results truly comparable. Some of each of the specimens were heat treated to form 24ST; some were pre-stretched to 3½ percent permanent set to form 24RT, some were aged at 350 deg F for 7½ hr, and a few specimens were anodized for 30 min in a chromic acid tank. The specimens were then subjected to one of the following corrosive treatments:

1. Salt spray—250 hr exposure at 95 deg F. to a finely-atomized spray

Details of hat stringers used in connection with tests on 30 40 in. flat ended plate-stringers in compression where both stiffeners and sheets had been aged. Results of these tests are shown in Table VI.



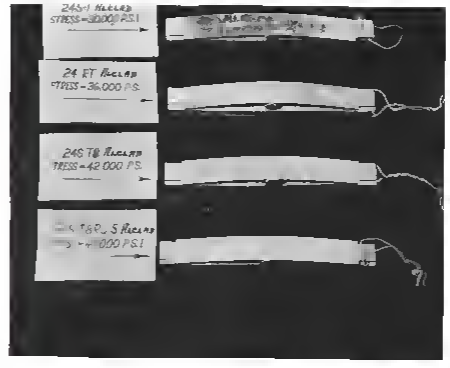


Fig. 25. Typical stress corrosion test specimens at CVAC Laboratories after 250 hr of salt spray exposure. Risers at center of jigs consist of segments of rods with varying dimensions to give different bends.



Fig. 26. CVAC test engineer loads new air oven built especially for studying aluminum alloy aging and associated problems. Test specimens have been carefully loaded to permit heated air to reach all parts, thus maintaining uniformity of mechanical properties.

MAKE THEM MORE AND MORE AUTOMATIC



DOUGLAS A-24 BANSHEE
OFFICIAL PHOTOGRAPH U. S. ARMY AIR FORCES

TO INCREASE THEIR FIGHTING POWER ★★★

White-Rodgers automatic temperature modulation equipment relieves pilots for greater concentration on fighting power by providing completely automatic control of

1. Engine cowl flaps (both air and liquid cooled.)
2. Oil cooler shutters or flaps.
3. Cabin temperature (both super-charged and normal.)
4. Carburetor air temperature.

Upon request, engineering data will be furnished to manufacturers requiring controls for the above or other temperature control applications.

LET'S GO! U.S.A. · KEEP 'EM FLYING!

WHITE-RODGERS ELECTRIC COMPANY
SAINT LOUIS, MO.

consisting of a 20 percent solution of NaCl in San Diego tap water

2 Accelerated—24 hr immersion, at room temperature, in a solution containing 57 grams of NaCl, 100 cc of 3 percent hydrogen peroxide, and 900 cc of distilled water

A microscopic examination of portions removed from the aged 24S Alclad specimens prior to tensile testing indicated no intergranular corrosion on the clad surfaces The unprotected edges of the aged Alclad specimens showed evidence of being corroded intergranularly at a few points around the perimeters A micrographic examination of the unclad control specimens, however, indicated only slight intergranular corrosion over the entire specimen, as shown at lower right of Fig 24

After their respective treatments, all tensile specimens were tested on a 120,000-lb hydraulic testing machine, using an autographic type of stress-strain recorder for determining the yield strengths

Table IV shows some representative corrosion tests on 0 091 in 24S Alclad sheet aged at 350 deg F. for 7½ hr The results are very disappointing in one expecting to see rapid reduction of yield stress and elongation with increase in time of immersion However all the specimens shown are 24S Alclad and the changes in properties were negligible in most instances.

Some tests were made in 1941 at CVAC (San Diego) to determine the corrosion characteristics of A17ST and 17ST rivets driven in 24ST and 24RT Alclad and aged at 355 deg F. for 9½ hr. Four 1x8-in. panels were made, each from two thicknesses of 0 091 in 24ST Alclad sheet two using 17ST rivets and two using A17ST rivets Four additional panels were similarly made from 24RT Alclad sheet The eight test panels were then aged 9½ hr at 355 deg F One aged 24ST panel with 17ST rivets, and one 24ST panel with A17ST rivets were subjected to a 20 percent NaCl salt spray corrosion test at 95 deg F for 250 hr

A similar combination of test specimens were subjected to the above-mentioned accelerated corrosion medium at room temperature for 24 hr This test procedure was duplicated using the aged 24RT panels After completion of the corrosion tests, all the riveted panels were sectioned, polished, etched, and examined microscopically for intergranular corrosion The rivets and the adjacent Alclad sheets showed no intergranular corrosion after exposure to the NaCl-H_2O_2 accelerated corrosion medium at room temperature for 24 hr, and there was little or no evidence of surface corrosion after exposure to a standard 20 percent NaCl salt spray at 95 deg F. for 250 hr.

(*Turn to page* 284)

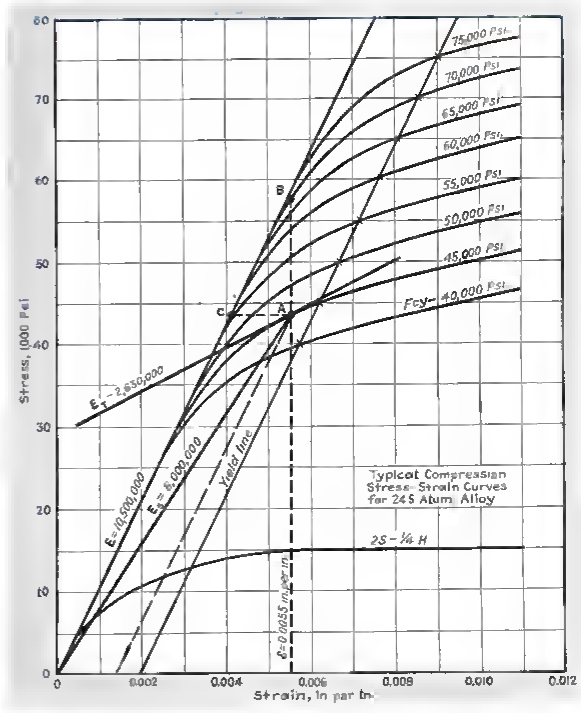


Fig 27

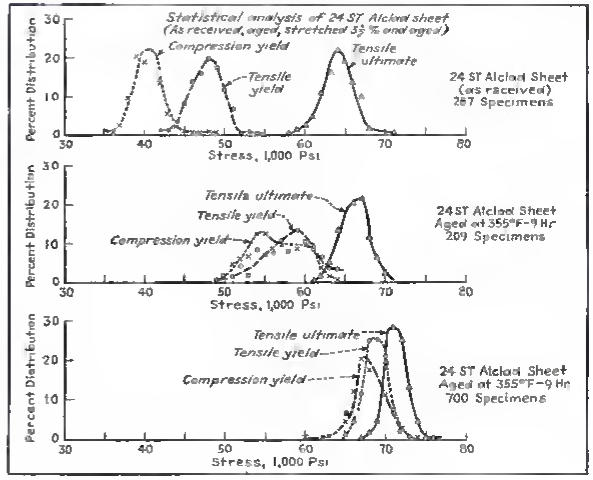
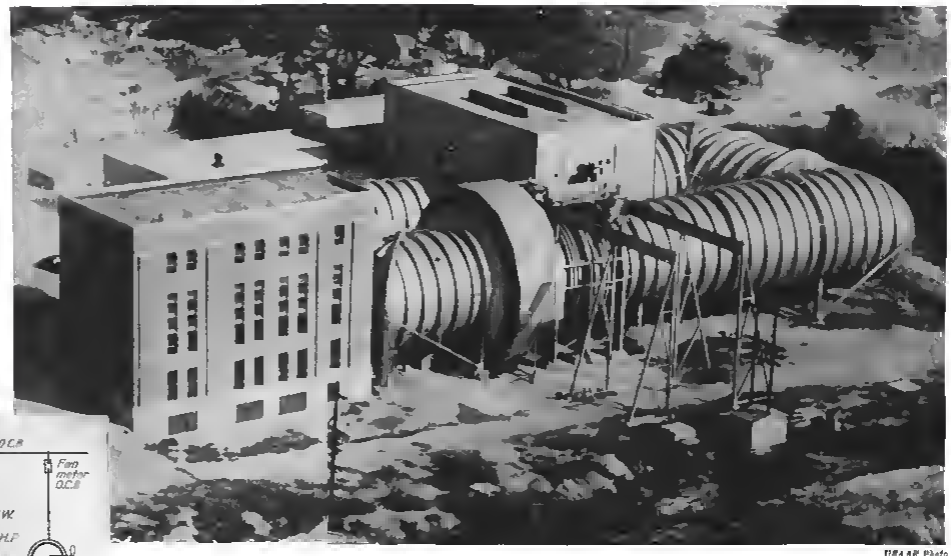


Fig. 28

Fundamentals of Wind Tunnel Control

By R. R. LONGWELL
Switchgear Engineer, Westinghouse Electric and Mfg. Co.

Tornadoes are tame compared to the blasts which travel through modern wind tunnels. Ever-accurate control is essential. Described here is the intricate apparatus required to attain it.



USAAF Photo

Fig. 2 Wright Field 20-ft tunnel.

THERE EXIST TODAY numerous wind tunnels in various parts of the United States, varying in size and power requirements from a few horsepower to the super 40,000-hp tunnels at Wright Field. Since each tunnel is a laboratory application, the applications vary as do the ideas of the operating forces of each installation. The main drive units vary from simple shunt wound d.c. motors, with field control of speed, to the more complicated Ward-Leonard control using multi-unit equipment and to the scheme employing the Kramer control system and a wound rotor induction motor for driving fan.

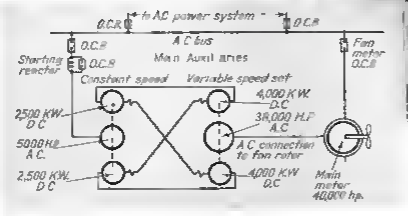


Fig. 1. Diagram of connections to wind tunnel motor.

Low power tunnels, using only d.c. motors for fan drive, utilize the simplest method of manual adjustment of field current in obtaining the desired fan speed. With this type of unit, a constant field current regulator is all that is used for maintaining uniform speed at any point in the operating range. On the larger installations more accurate speed control is employed, this keeps fan speed constant within 3 per cent at any speed setting. For test operation flexibility, speed setting accuracy is as necessary as accuracy of control.

As main drive units increase in size, other factors become increasingly important. Consideration must be given to (1) Protection of all machines involved, (2) power factor control in order to maintain efficient operation of all apparatus involved, (3) prevention of shock to the power system by guarding against sudden changes in power requirements by switching or control operations. In all cases, flexibility of operation is an important factor. Since most new tunnel installations now under construction are 10,000 hp or larger all of the aforementioned requirements are important.

Flexible and accurate speed adjustment is provided by a rheostat assembly composed of all shunt and series field rheostats necessary for use with the d.c. main drive units. Combining all rheostats in one assembly provides simultaneous control of the fields of all machines. This permits accurate calibration and adjustment of all units on the basis of machine test data and it insures correct functioning of machines on repeated operations. In conjunction with the multi-unit rheostat, constant current regulators are often used for the fields of the d.c. machines. Such regulators are recalibrated for each speed setting desired by units of the multi-unit rheostat. They hold motor and generator field excitation at a fixed value, assuring uniformity of power output.

Where extreme accuracy of speed regulation is required over a considerable period of time, a pilot generator—mounted on a fan drive motor—is used in conjunction with an electronic speed regulator. The electronic regulator is calibrated for each speed setting by means of a wire-wound rheostat having 4000 turns. This rheostat also serves as one of the units of the speed adjusting rheostat. When the rheostat is stopped at a point which provides the desired fan-speed setting, the electronic regulator operates to maintain that speed constant within a fraction of 1 percent by control of the field excitation on one of the d.c. machines of the main drive equipment.

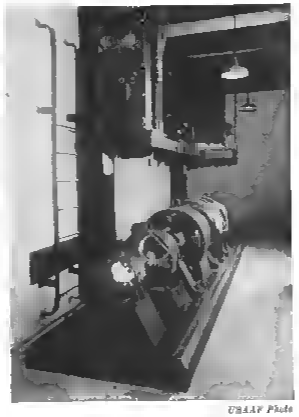
Speed of the fan drive motor is interpreted in terms of d.c. voltage by the pilot generator applied as a bias voltage on the control grids of vacuum tubes in the electronic regulator. A change in grid bias is instantly followed by a change in machine excitation of such magnitude as to prevent further speed change. This corrects the deviation which has occurred, assuming minute adjustments and accurate regulation of speed for any specific setting.

Where the wind tunnel fan is driven by a d.c. motor and a wound rotor induction motor combination, operation of the multi-unit speed control rheostat is automatically coordinated with that of the liquid slip regulator for the induction motor. Such a system is employed in the new tunnel under construction at California Institute of Technology. The control is so arranged that the d.c. motor carries full load at all times and utilizes overload capacity for speed regulation. The liquid rheostat is adjusted to permit the induction motor to assume more or less load de-

(*Turn to page 354*)



Fig. 3. View of constant speed generator set and variable speed generator set, Wright Field 20 ft. tunnel power plant.



USAAF Photo

Fig. 4 Exciter set and speed control rheostat of tunnel.



USAAF Photo

Fig. 5. Seen above is the control room for the 20-ft. wind tunnel at Wright Field.



USAAF Photo

Fig. 6. Wright Field wind tunnel power building showing motor balcony. Note (center) contrasting size of desk.



FORGINGS . . . IN AIRCRAFT ENGINES

Photo of Wright 14" Cyclone Engine

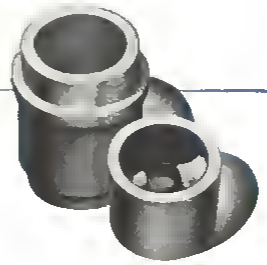
FORGINGS in aircraft engines? Of course! Cylinder barrels . . . pistons . . . heads . . . these are typical parts that are being forged today in ever-increasing quantities. Why? . . . because forging and precision heat treating imparts metallurgical advantages that make these parts do a better job.

Tube Turns' flexibility in both manufacturing and thinking—a willingness to try new methods, to improve processes and procedures—makes our cooperation unusually worthwhile and timely for the aircraft industry.

Fine forging can vastly improve the quality, life and effectiveness of many aircraft parts. You are invited to draw upon Tube Turns' broad experience, resourcefulness and facilities on any war production problem concerning forgings.

TUBE TURNS (Inc.), LOUISVILLE, KY.

Steel cylinder barrels and aluminum pistons are just two of the many products forged by Tube Turns. (Cylinder barrel forging illustrated has been rough machined)



TUBE TURNS

FORGINGS FOR INDUSTRY



NON-CONDUCTING MATERIALS HEATED FAST WITH THERMEX



Take airplane parts for example:

PLASTICS: Control knobs and handles. Radio parts. Instrument panels. Engine parts.

PLYWOOD: Propellers. Spars. Ribs. Skins. Crew seats.

RUBBER: Such as miscellaneous molded mountings for parts that must ride in rubber.

INSULATING MATERIALS: Fuselage. Radio. Ignition. Fuel tanks.

BUY another WAR BOND THIS WEEK

For heating practically any non-conducting material, investigate the suitability of Thermex high frequency equipment.

Heating with Thermex offers many speed, quality and production advantages heretofore impossible. Temperature is uniform regardless of thickness or area of product. Heating time is reduced from hours to minutes in many cases—is under complete control every moment.

The GIRDLER CORPORATION

Thermex Division • Louisville, Kentucky



THERMEX

HIGH FREQUENCY EQUIPMENT

FOR HEATING NON-CONDUCTING MATERIALS

A GIRDLER PRODUCT



How transparent plastic shield is used in final inspection of blades.

Plastic Shields Speed Blade Balancing

Accelerated production of propellers has been achieved in one Frigidaire plant through the novel use of a transparent plastic shield to guard propeller blades from drafts during delicate balancing operations. Since operator had to make this test frequently to make certain he was not grinding off too much metal a lot of time was wasted which might have been saved if the balancing could have been done on the grinding bench. To do this, however, something had to be done to prevent drafts from striking the blades.

Answer was found in the special transparent protective shield (see photo) which effectively protects the blade while permitting the operator to see the position in which the blade finally comes to rest. As a result, the time required to check the balance of a blade has been materially reduced—in fact, it is now a matter of seconds.

The new device has worked out so well on the hundreds of blade grinding benches in the plant that it is also now being used in final inspection, where highly trained teams of men and women double check the balance of the blades before they are assembled into the finished propellers, thus not only saving time but assuring more accurately machined blades.

Propeller Blades On Merry-Go-Round

A merry-go-round of 40 ft. dia. gives new propeller blades a curing ride in the East Hartford, Conn., plant of Hamilton Standard Propellers Div., United Aircraft Corp. The machine is a 100-ton rotary unit for curing rubber fairings, or cuffs. In design and conception it is completely novel, states the company.

The huge steel turntable turns on rollers mounted on a concrete foundation. The outer rim of the table is flat and is divided into 42 separate slots, each of which is a sector carrying a half-ton mold into which the blade fairing assembly is inserted for curing. Each slot has its individual system of air, steam, water, and electricity, automatically controlled through cam-operated valves and Bristol pressure controllers. Main supply lines are brought in through the center of the turnable by swing joints and slip rings.

Simultaneously, the machine cures two sets of 21 blades. Each mold starts at a loading station, turns to a gap-type hydraulic press, then moves successively through a steam heating cycle, a water cooling cycle, and finally to an unloading station half-way around the circle. At the last point a similar cycle is started and repeated on the other half-circle.

The machine turns intermittently clockwise, advancing one blade sector every 12 min., activated by a pneumatic ratchet drive from a 14-in. air cylinder connected to the shop's regular compressed air lines. This movement allows just over four hours for each curing cycle, or half turn of the table. A complete revolution therefore requires more than eight hours.

First step in the operation is to coat the inside of the mold at the loading station with wax, after which the steam in that mold is turned on. A blade, about which a fairing has been built by hand from molded pieces of sponge rubber, covered with sheets of uncured ebonite, is then inserted into the mold, which is loosely bolted. The turn of the table carries the mold under one of the two 100-ton Farquhar hydraulic presses, which closes it under pressure. This forces out excess rubber and allows the mold bolts to be tightened.

After the mold with its blade advances to the next position a canvas and wool insulation blanket is put over it to conserve heat and protect workers. The table then carries the mold by progressive steps about one-third of the way around its circle, completing the heating cycle under steam pressure. At this point the heat is turned off and refrigerated water is circulated through



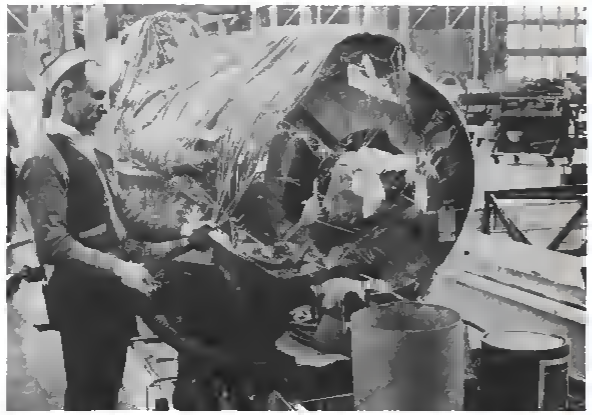
This 42-ft.-dia. machine is used for curing Hamilton Standard propeller blade cuffs at company plant, East Hartford.

the mold. Blade and mold are then cooled for a little over an hour until the combination reaches the unloading station which is 180 deg. from the loading point.

The Farquhars are among the largest open-sided presses ever made. The mountings of the rotary table near the presses are on steel springs so that there will be a slight "give" to bring the table into contact with the lower platen of the press while the mold is being closed. When the pressure is released the table lifts and clears the lower platen by approximately ¼ in.

Six electric hoists travel on an overhead track to open and close molds. Two are of 2,000 lb. capacity, and four of 1,000 lb. These are supplemented by two 500 lb. crane hoists.

The device was planned by Hamilton Standard tool and equipment engineers to provide continuous, uniform molding of the rubber fairing with a minimum of handling. The design and building were carried out by L. Heres De Wyk Co., Ansonia, Conn.



Method of collapsing Pliofilm bag after sealing. Inside, bags of silica gel are fastened around propeller shaft to absorb moisture.

Shipping "Raincoat" For P-40 Bodies

Rust and salt water corrosion, dust infiltration, and moisture damage were formerly problems in the shipment of planes to distant war fronts. Although portions of the planes were coated with protective grease, there remained many others, such as instruments and radio, that were not able to be safeguarded by this method.

Considerable work went into applying the protective grease film. When the ships reached their destination each part had to be cleaned before assembly. The grease was difficult to remove. Some fronts lacked the facilities for removing the grease, and in dusty and sandy regions there was a tendency for grime to adhere to the craft.

Hence, Curtiss Wright was interested in the method used by the engine manufacturers for shipping their products. Using a Goodyear Pliofilm bag, the engines were enclosed, dehydrated, and sealed before shipment. Then the company and the manufacturers of Pliofilm went into a huddle regarding possibilities of an oversize "raincoat" for an airplane. Upshot was the P-40 fuselage Pliofilm bag (see photo).

The new fuselage raincoat has only four holes in it, through which the fuselage carriage support studs are inserted after the fuselage is ready to be bolted down. The method of placing the Pliofilm raincoat on the P-40 is simple, although care must be taken to assure that no part of the bag is torn.

After the bottom of fuselage box has been built and the welded iron support bolted into place, the 30-ft. Pliofilm bag is laid flat over the floor of the fuselage box. Studs are inserted through the holes in the Pliofilm, the complete fuselage and motor unit are lowered onto the support, and cardboard stiffeners are used as self-sealing washers at the point where the Pliofilm bag is perforated.

The process of dehydrating the P-40 is commenced by tying bags totalling about 40 lb. of silica gel about the propeller hub and the engine, as well as the instrument panel and accessories. Through this dehydrating process, active chemicals eliminate the moisture that is such a menace during shipment. Mounted on a cardboard base in a visible position a chemical compound maintains a blue color if the humidity inside the bag is safe. If unsafe, the color of the chemical changes to a warning red. When the P-40 is finally created, an inspection port is left in the side of the box in front of the humidity indicator and a check of its condition is made at frequent intervals.

Buttoning Coat

The P-40 is now ready to be fitted with its raincoat. The Pliofilm bag is pulled up and around the plane from propeller hub to tail, and the process of closing the long seam begins, sealing the bag so that no air can seep in. This is done by means of an adaptation of the familiar electric soldering iron fitted with a roller. While one man folds the seam another operates the electric unit, with which the bag is made airtight. After the bag has been sealed, a tube is inserted into an opening in the bag and is attached to a vacuum arrangement which sucks out most of the existing air. Through this process, the amount of air inside the bag is reduced to a minimum, thus lessening the quantity to be dehydrated by the silica gel. The P-40 is now in a state of preservation in a waterproof, dustproof, and water repellent coat.

Carboloy Tools Speed Scraping Process

The worn-out file has become a war casualty. Not so long ago it was carefully saved for transforming into a scraper, in which role it served through another period of usefulness. Now, however, file steel is no longer able to hold down the job of hand-scraping the ways of machine tools—for time is too precious to permit the operator to spend it in frequent honing of his scraper. So Carboloy cemented carbide scrapers are now reported being used in this type of work.

Accelerated production of machine tools was the prime cause of the development of this new tool. Another reason was that the introduction of flame-hardening caused spots which could not be touched by the old style scraper, but which Carboloy tools are reported to cut away with comparative ease.

For instance, it was found that cast iron with a Rockwell hardness of around 40 could be scraped at a rate of over 25 sq. in. per grind, whereas a file steel scraper would not touch the surface at all.

An additional advantage in the new material is reported by the Carboloy Co., which finds that tools made of the material have no tendency to dig into or scratch the surface being worked upon.



UNITED STATES RUBBER COMPANY

1230 Sixth Avenue • Rockefeller Center • New York 20 N Y

BLITZING A BLIZZARD WITH USKON

Rubber has always been the greatest non-conductor of all. But today it has a new role. Modern science in the laboratories of the United States Rubber Company has made it a material that can conduct electricity in a new, unique type of heating element, called USKON.

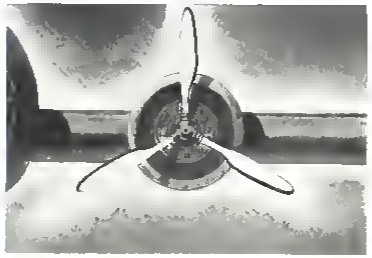
These elements are flexible rubber sheets that produce heat uniformly over their entire surface when attached to an ordinary electrical outlet.

Right now one of the outstanding uses of USKON is to keep propellers of airplanes free from ice. One of the USKON units is applied along the leading edge of the blade. The passage of an electric current through the material produces sufficient heat to prevent ice from forming . . . a distinct advantage over devices which function only after the ice has formed. Only minute weight is added to the plane and its flying power is not reduced.

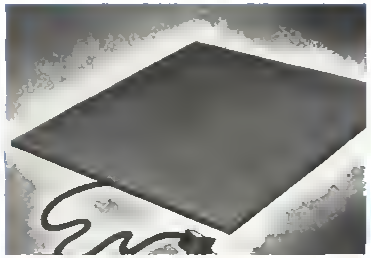
It is obvious that USKON must be devoted solely to the war effort. All production is dedicated to these vital jobs in the Armed Forces and in war industries. A few of the important industrial applications of USKON are described briefly here.



Plants that make self sealing fuel cells for airplanes vulcanize portions with heating pads of this remarkable new synthetic rubber material



The narrow black strip you see on the edge of the propeller blade is an Uskon heating unit. Crippling ice that might possibly force the plane down cannot form



This square pad of Uskon may not look particularly spectacular but it is one of the outstanding developments in synthetic rubber. Plugged into an ordinary light switch, it becomes a heating element readily carried wherever it is needed



To move primers and detonator powders from the mixing room to the loading building with safety, a girl carries a tray of small conductive rubber boxes filled with the sensitive explosives. Another example of the utility of Uskon . . . and of synthetic rubber

RUNNING STATIC INTO THE GROUND

When a plane is refueling, a static spark may be "bad medicine." Even a weak spark hardly noticeable to the touch may be enough to cause a serious fire. United States Airplane Refueling Hose is specially constructed to protect against static at all vital points—and U. S. Royal Static Conductor Tires run static into the ground. More about these new tires on the next page.



HOW U. S. ROYAL STATIC CONDUCTOR TIRES BURY STATIC WHEN THE AIRPLANE LANDS



For years, automotive and aircraft engineers have known that static electrical charges built up during the run must be "bled off" before they can cause damage. The familiar chain that trails behind gasoline trucks is one way the problem has been licked in highway transportation.

But in the air, a trailing chain or dragging wires are not satisfactory answers. So the problem was put up to the rubber chemist. "Could rubber that had always been regarded as a perfect insulator be made over into a good conductor of electricity?"

U. S. Royal Static Conductor airplane tires are the answer to that question. Through rubber chemistry and tire engineering, these tires have become conductors of electricity. They provide a path which leads the static charges harmlessly into the ground. These new tires reduce the hazard of sudden shock to ground crew men and the danger of fuel fires caused by static.



U. S. ROYAL
Nose Wheel Tire



U. S. ROYAL
Landing Wheel Tire



U. S. ROYAL
Tail Wheel Tire



U. S. ROYAL
Ice Grip Tire

If you have not used U. S. Royal Static Conductor tires on your planes, write us for complete information today. They are available in all standard sizes for nose wheels, landing wheels and tail wheels and in the new "U.S." Ice Grip construction. Your nearest "U.S." Field Airplane Tire Engineer will gladly work with you on this or any other airplane tire or tube problem.

UNITED STATES RUBBER COMPANY

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Favoring Factors For Aircraft Investments

By H. L. FEDERMAN

Cited are reasons for optimism regarding the future of aircraft investments.

Lone in the unwanted "war baby" category, aircraft securities are now beginning to get increased investment support. This condition stems from a combination of factors which deserve careful attention.

All things are relative. The market discounted war profits and their effect on war industries prior to hostilities or shortly thereafter. As a result war beneficiaries such as aircraft stocks not only failed to experience any sharp gains in the market place but actually declined. For the most part, this has followed prognostications, since the aircraft builders' boom volume of business is of the "profitless prosperity" variety.

This market condition in respect to aircraft equities has prevailed since the outbreak of war in Europe, or for more than four years. On the other hand, during the last six months or so the market has begun to discount peace with the resultant effect of a substantial burst in values of those equities tinged with a "peace" flavor. This discounting process has gone a long way. Many market observers are now beginning to question the advisability of continued investment in those "peace groups" which have experienced material price rises. In other words, recognition is now accorded the fact that inordinate profits are somewhat limited and completely out of proportion to the risk entailed in staying with those issues.

The glamour of many "peace" companies fades rapidly when placed under the microscope. The air transport group is one example. It is true commercial aviation will experience tremendous gains once the war is over. But just how profitable will the airlines find themselves? It is difficult to overlook the strong government regulation and its consequent control over all forms of rates, to say nothing of the power of life and death contained in the award of new routes. Further, expansion and development programs consume considerable capital and are hardly conducive to immediate profits. In substance, such are the elements mitigating against immense gains by the air carriers.

A strong parallel exists in the electric power industry. This group has experienced tremendous technological progress and even without war-inspired activity was constantly increasing its output of power. The trend of profits, however, not only failed to keep pace with power production, but it actually declined. The cause: A steadily declining rate received per kilowatt of power plus increasing taxes.

In viewing these factors, it is important to weigh the level of earnings which current market prices for airline equities seem to denote. By contrast, aircraft securities are evaluated very modestly in relation to current and future earnings. It is difficult to overlook the fact that at the start of hostilities certain motion picture shares fell very sharply on the belief that a prolonged war would ruin the industry's foreign markets. In many cases prices of securities sold below the amount of today's war conditioned net profit per share. The public guessed incorrectly at the outset, but it did not take very long for a more accurate appraisal to become evident in rising prices for motion picture shares.

All this simply means that there is a good possibility that aircraft securities may have been oversold. Public enthusiasms range from one extreme to another. The search may soon be on for hidden opportunities in deflated groups and it is very probable that the aircraft industry may once again assume its shining luster in the eyes of the investing public.

Ironically enough, the much maligned tax laws may be the source of strength for investor enthusiasm toward aircraft shares. At the present time, federal taxes—and frequently state levies—take a heavy toll of earned income for those in the higher brackets. The only hope of securing an accretion to capital or spendable income is through a capital gain, the tax impost being only 25 percent if held for at least six months. This may serve to induce money to flow into such depressed groups as aircraft shares, where it is clearly evident that if any market prices accrue they will not be in the immediate future. And this type of capital runs to material proportions and can make its influence felt.

The 1942 Revenue Act, onerous as it is, has a number of beneficial qualities which will be of unmeasurable value to the aircraft companies. Largely ignored at one time, the "carry-back" provisions of the tax act may go a long way in saving the day for the aircraft and other "war" industries.

In substance, those provisions which are concerned with "carry-back of losses" and "carry-back of excess profits credits" provide a safety valve for many industrial groups. In fact, some quarters assert that Congress, consciously or not, has provided through this measure, the first substantial piece of post-war planning to be placed in effect. Certainly, if Congress is aware of this feature, no one in that august body has as yet advanced to take credit for this plan.

The sections of the Revenue Act in question provide that if, within two years following a period when the company has been paying excess profits taxes, it may re-adjust the tax paid in the previous profitable period. Moreover, if losses are incurred in subsequent years, they may be carried back for two years against the profits previously reported, with a claim for a tax refund.

To see how these provisions operate it may be well to examine briefly the present tax law. Corporations are primarily concerned with two kinds of taxes. There is the 40 percent tax paid on so-called "normal prewar" earnings. Another tax of 90 percent is due on all earnings in excess of "normal" earnings. This is the excess profits tax.

(*Turn to page* 313)

TABLE I—EXAMPLE OF COMPANY TAX COMPUTATIONS

Earnings	$10 000 000
Less amount of "Normal" Earnings	4 000 000
"Excess Profit"	6 000 000
Taxable at 90 percent or	$ 5 400 000
Normal Tax of 40 percent on $4 000 000	1 600 000
Total Tax	$7 000 000

TABLE II—AMENDED TAX COMPUTATIONS

Earnings ($10 000 000 less $5 000 000 loss carried back")	$5 000 000
Reduced by amount of normal earnings	4 000 000
Excess profit	1 000 000
Taxable at 90 percent of the $1 000 000 less 10 percent, or	$10 000
Normal tax of 40 percent on $4 000 000 or	1 600 000
Total Tax	$2 410 000
Total refund due (difference between previous net tax bill of $6,460 000 and $2 410 000) or	$4 050 000

TABLE III—BARRON'S STOCK AVERAGE

	Aircrafts	Air Transport	50 Stocks
Sept 5 1943	28 08	40 00	79
Sept 2 1943	28 25	38 81	79
Aug 26 1943	28 85	37 69	78
Aug 19 1943	28 50	38 75	79
Aug 12 1943	29 25	38 12	78
Aug 5 1943	29 25	36 81	78
Aug. 28 1942	29 12	30 28	60



Valsparred EDO Floats help sink the Axis!

Global war is tough on men and materiel. The elements are enemies no less than the Japs and Nazis. It takes guts to stand up and deliver under the incredibly cruel conditions of Alaska, the South Seas and Africa.

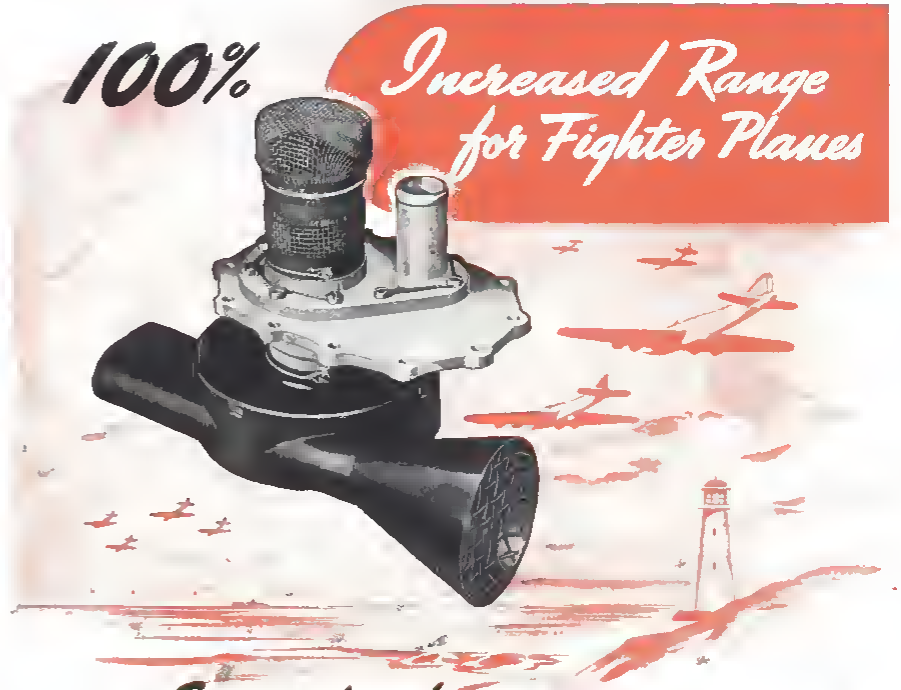
But American boys are proving themselves equal to the task—and American equipment is in there fighting, too. Beating the worst our enemies can dish out!

Meeting requirements everywhere, EDO Floar Gear serves the United Nations on all fronts.

And Valspar serves EDO—with the finest, toughest aircraft finishes superior skill can supply.

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ROMEC K-1 BOOSTER PUMPS

on disposable auxiliary gasoline tanks

Now fighter planes are flying the oceans and keeping pace with the long range bombers. The new ROMEC PUMP illustrated is used with the droppable fuel tanks which are slung under the wings. Wind-driven, it mounts in the sump of the disposable auxiliary fuel tank. This is another ROMEC AIRCRAFT PUMP development helping to speed the Day of Victory.

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FIRST IN DEPENDABILITY

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BUY WAR BONDS



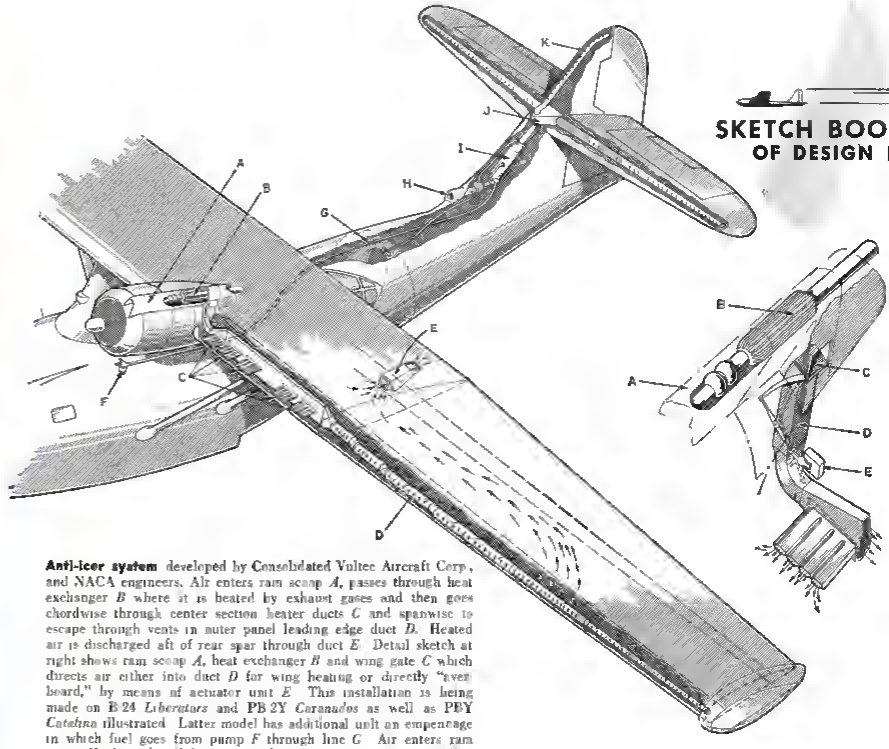
This toast (and others like it) is frequently heard when American pilots and their crews return from difficult missions. It results from the stubborn dependability and unexcelled fighting qualities of American planes. This ability to absorb terrific punishment and continue to "dish it out" is told in daily news reports from all our fighting fronts.

These reports are a tribute to the entire American Aviation Industry as well as to the brave men who fly the planes. We at Vickers are proud of the dependable performance of the Vickers Hydraulic Equipment that is used on the great majority of our country's combat planes.

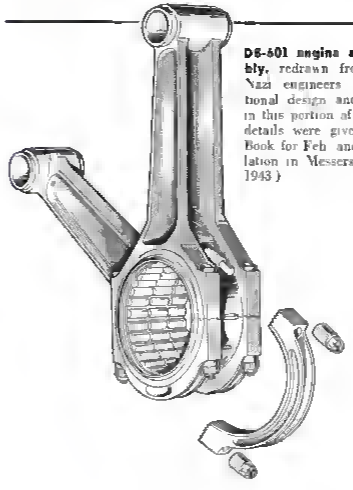
VICKERS Incorporated
1462 OAKMAN BLVD. • DETROIT 32, MICHIGAN

VICKERS
HYDRAULIC
EQUIPMENT

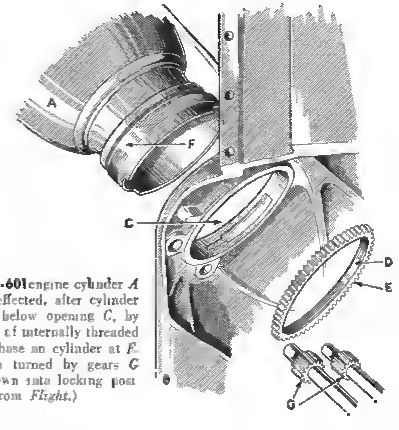
Engineers and Builders of
Oil Hydraulic Equipment Since 1921



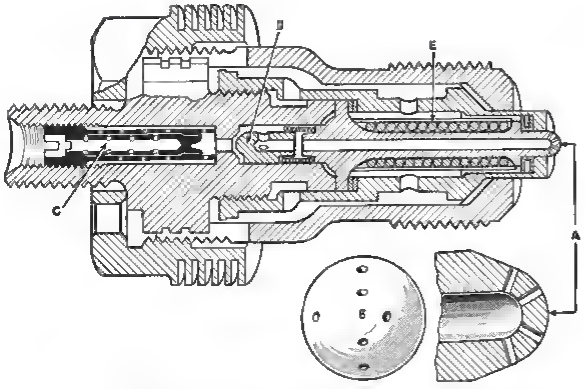
Anti-icer system developed by Consolidated Vultee Aircraft Corp., and NACA engineers. Air enters ram scoop *A*, passes through heat exchanger *B* where it is heated by exhaust gases and then goes chordwise through center section heater ducts *C* and spanwise to escape through vents in outer panel leading edge duct *D*. Heated air is discharged aft of rear spar through duct *E*. Detail sketch at right shows ram scoop *A*, heat exchanger *B* and wing gate *C* which directs air either into duct *D* for wing heating or directly "over board," by means of actuator unit *E*. This installation is being made on B-24 *Liberators* and PB-2Y *Coronados* as well as PBY *Catalina* illustrated. Latter model has additional unit on empennage in which fuel goes from pump *F* through line *G*. Air enters ram scoop *H*, through tail heater unit *I*, plenum chamber *J* to leading edge ducts *K*.



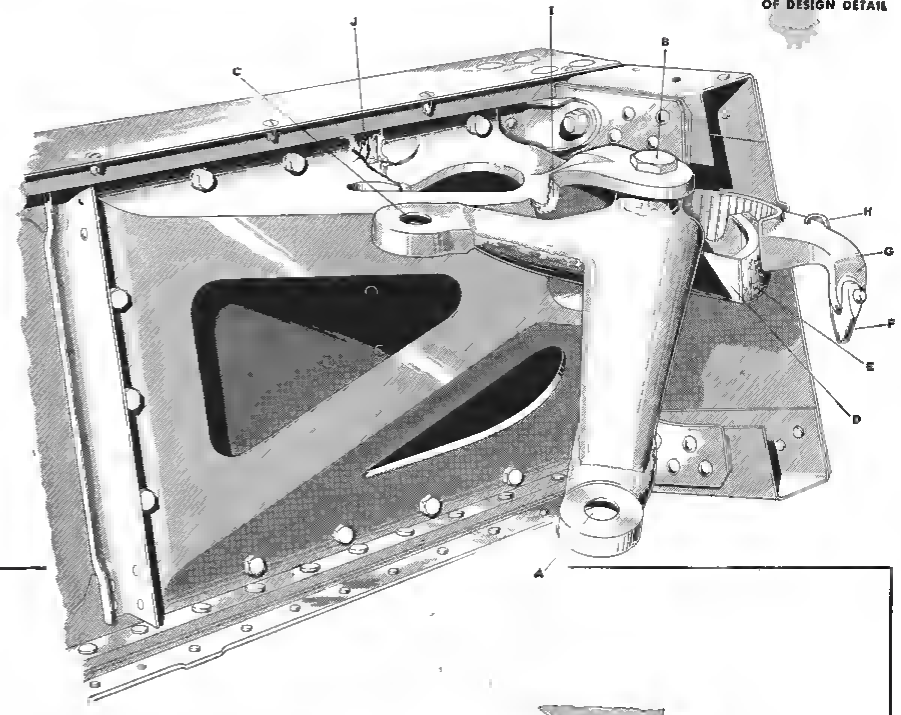
DB-601 engine connecting rod assembly, redrawn from *Flight*, reveals that Nazi engineers have followed conventional design and construction practices in this portion of engine. (Other DB-601 details were given in Aviation's Sketch Book for Feb. and May, 1943, and installation in Messerschmitt Me-109 in Mar. 1943.)

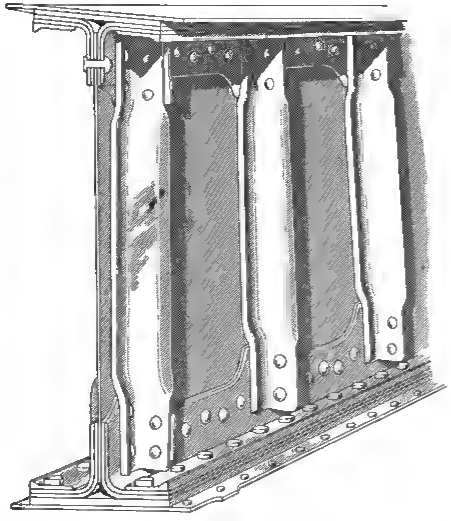


Attachment of DB-601 engine cylinder *A* to crankcase *B* is effected, after cylinder has been brought below opening *C*, by engaging threads *D* of internally threaded ring gear *E* with those on cylinder at *F*. Ring gear is then turned by gears *G* to pull cylinder down into locking position. (Re-drawn from *Flight*.)

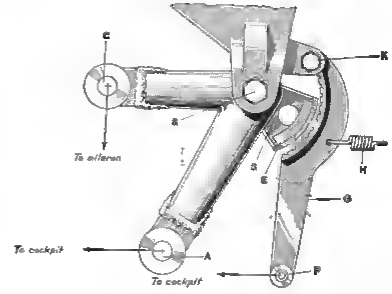


Details of Mercedes-Benz DB-601 engine, redrawn from *Flight*, showing fuel injector and nozzle at left and section of cylinder, showing liner fixing and position of injector at right. Nozzle is at *A*, with detail *B* showing location of 0.32 mm. diam. holes. Labyrinth filter is at *C*, non-return valve at *D* and lagging at *E*. Sketch at right shows nozzle at *A*, injector as a whole at *B*, cylinder liner *C*, crankcase *D* and geared locking ring *E*



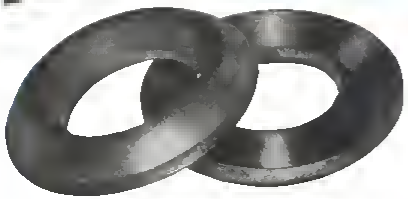


"Made in Japan, finished in Pearl Harbor"—Dec. 7, 1941, 8:37 A. M.—such is the history of the Aichi 99 dive bomber from which come accompanying sketches of a portion of the rear wing spar with aileron hinge fitting. At left is a cross section of the spar, showing how it is built of aluminum alloy. Spar depth here is 6⅞ in.; width at top is 3¼ in., while bottom is 3⅝ in. It is interesting to note that, in addition to use of well known construction principles, numerals and letters stamped in aluminum are *not* in Japanese. At above right is shown the aileron hinge fitting, built up of heavy cast aluminum. Control cable from cockpit is fastened to control arm at *A*. Hinge point is at *B* with control cable to aileron itself fastened at *C*. Also shown is a flutter-damper to which pilots of this type of craft have to resort in dives. Built into aileron control is "brakeshoe" *D*, lined with cheap leather *E*. A pilot-controlled cable attached at *F* pulls arm *G* against the lining to counteract flutter set up by aileron. Clamp *H* forms end of small elastic cable which pulls arm away from lining upon release of tension by pilot. Points *I* and *J* trace course—from rear to front—of one of American bullets which brought the plane down. At right is a diagrammatic view showing *A* where aileron control cable fastens, *B* hinge point, *C* aileron control cable connection; *D* brakeshift "brakeshoe", *E* lining; *F*, cable-to-cockpit connection, *G* flutter-damper arm; and *H* release cable connection. It was noted that bearing at *K* bore initials of a well known German firm.



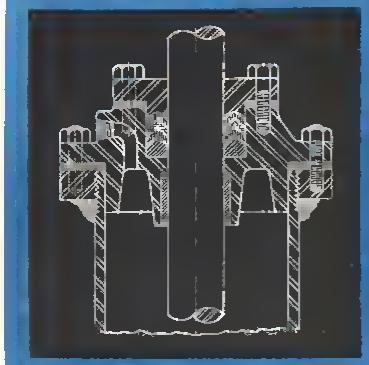
GRATON & KNIGHT Engineers Present

PACKINGS POINTERS



THE VEE PACKING — The Vee is becoming the most popular of all types, having proved equally efficient as a piston head packing or a stuffing box packing, in both hydraulic and pneumatic applications. It is used with reciprocating or rotating members at low or high pressures. It is especially successful on applications involving high shaft speeds and highly abrasive metals.

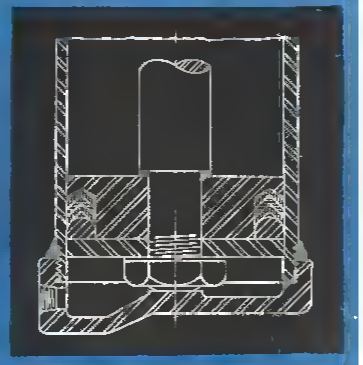
The Vee consists of two sealing lips connected by an outside leg and an inside leg hinged at the apex. It is usually used in sets of 3 to 6, with 4 generally recommended. It is a self-sealing packing; it is installed with the sealing lips facing the pressure medium, and when expanded by the pressure, each lip forms a seal with the surface it contacts. It can also be used as a compression packing.



Vee packings . . stuffing box application

MAIN ADVANTAGES

1. Longer life - more leather to feed to the wear
2. Several sealing lips
3. Compensates better than other [illegible] properly [illegible] for [illegible] cut [illegible] es [illegible] rt[illegible]
4. Split Vee packing [illegible] installed with [illegible] moving plunger or piston rod



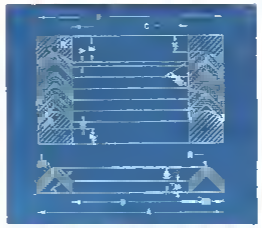
Vee packings . . piston head application



World's largest Industrial Leather Plant

GRATON & KNIGHT *Engineering*

DESIGN FEATURES



SPARTAN VEE PACKING DIMENSIONS

A = ID of cylinder or OD of stuffing box

B = OD of piston

CS (cross-section of packing) = (OD of stuffing box or ID of cylinder minus OD of piston or piston head) divided by 2

S (stack height of one packing) = T times 1.42

H (height of one packing) = ½ CS plus T minus 1/64"

R (radius) = T plus 1/64"

METAL ADAPTER RINGS DIMENSIONS

C = close fit as possible to mating parts

D = close fit as possible to mating parts

Y = CS times .15

E = Optional

K = Optional (¼ CS as minimum) or E minus (H minus S minus Y)

G = ½ cross-section of male adapter ring

X = CS times .207

F = optional (equal thickness of leather as minimum)

R (radius) = T plus 1/64"

Axial grooves are desirable on male adapter for free admission of medium to the packings

(NOTE for blueprint carrying above information, write us for Drawing G 16)

GRATON & KNIGHT Recommendations at the "Packing Point"

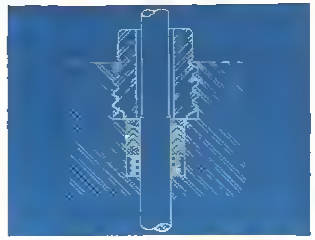
Case No. 1 Stuffing Box Application

Equipment hydraulic pump for capsule machine

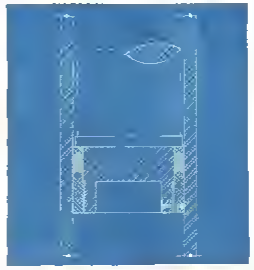
Operating conditions varying pressure from 0 to 1000 psi, stroke up to 11 3/8", maximum speed, 64 strokes per min.

Packing recommended Graton & Knight's Spartan Vee Packings treated for maximum working pressure of 1000 psi

Accessories Spring loading with total pressure of 25 lbs. insures satisfactory initial seal before pressure build up.



Case No. 2 Piston Head Application



Equipment airplane wing jack (20 tons)

Operating conditions AC 3580 oil, 165° F. to minus 65° F., atmospheric to 3000 psi pressure, heavy side loads, ram must return under weight of ram and locking device

Equipment design steel cylinder, steel ram, female adapter machined into piston head, excessive clearance to prevent scoring, bronze male adapter ring, made extra long to guide piston, close fit in cylinder.

Packing Graton & Knight leather packing especially impregnated for extra resiliency in order to maintain seal during eccentric loading and prevent leakage at extremes of pressure.

Special recommendations bronze or brass female adapter to support packing without danger of scoring cylinder.

CERTAINTY AT THE POINT OF SEAL

Graton & Knight's exclusive, special tannage, Spartan leather, is recognized as the top-quality packings leather because it has resistance to heat and oil of top quality chrome leather, mellowness, flexibility and body not found in the usual chrome tannage.

Graton & Knight's practical engineering service is your assurance of proper material and design for dependable, trouble free packings applications





the hand that builds certainty at the point of seal

GRATON & KNIGHT COMPANY

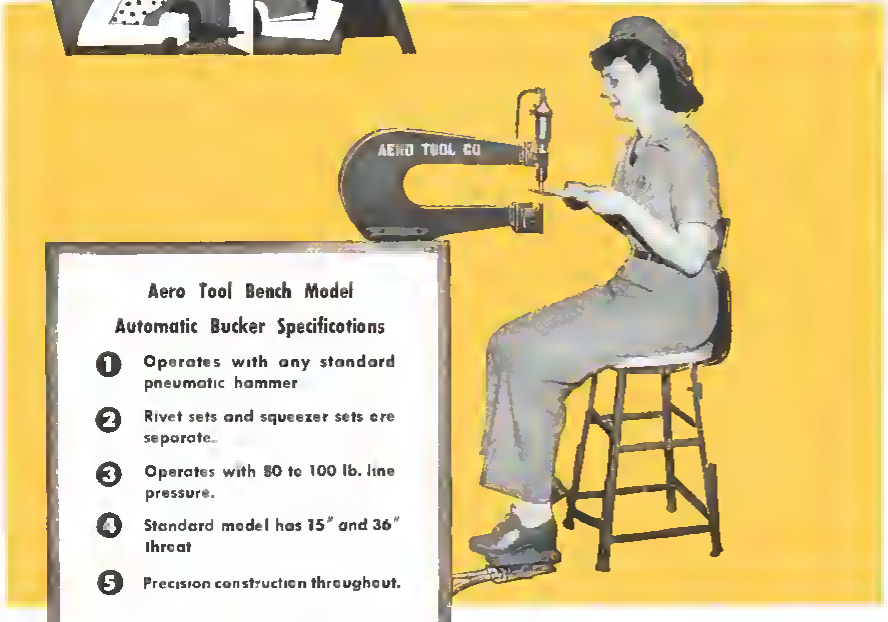
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WHY TWO WHEN ONE WILL DO?

Slash production time fifty per cent with the Aero Tool Automatic Bucker. Release one person for other work . . . *double* personnel productive capacity!



Aero Tool Bench Model

Automatic Bucker Specifications

1. Operates with any standard pneumatic hammer
2. Rivet sets and squeezer sets are separate.
3. Operates with 80 to 100 lb. line pressure.
4. Standard model has 15" and 36" throat
5. Precision construction throughout.

NOW ONE PERSON BUCKS AND RIVETS

IF increased production schedules in the face of manpower shortages and limited plant facilities are challenging your ingenuity, here is the tool you need. The Aero Tool Bench Model Automatic Bucker *Increases Production 100 Per Cent . . . Gives Uniform Riveting and Fewer Rejections . . . Speeds Bucking Operations!*

Investment cost is low, simplicity of operation requires a minimum of operator training. Its construction features and many uses make it the ideal high production method for all standard and many special upsetting applications.

This Aero Tool Automatic Bucker drives rivets instantly with perfect alignment. Various length rivets can be used without changes . . . no adjustments or pre-settings are necessary. Minimum vibration allows preloading. Treadle operated, both hands of operator are free for action.

The Aero Tool Engineering Staff is at the disposal of manufacturers to aid in adapting equipment to fit special requirements. *Write for Qualotrons and Details Today.*

DON'T SNAP OFF ITS HEAD!

When drilling out imperfect rivets don't snap out the rivet head with a twist drill. USE A PIN PUNCH — —CONSERVE TOOLS!

AERO TOOL CO.

ENGINEERED AIRCRAFT TOOLS

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Wink Supply Co., Dallas, Texas

Air Corps Materials

(Continued from September issue.)

Number	Name	Sizes	Code rule
#500 #501 AN502 #503 AN505 AN510 AN515 AN520	Screw, fil, hd. NC thd, 1120 steel, drilled or plain hd Screw fill hd NF thd., 1120 steel, drilled or plain hd. Screw, fill hd NF thd., 2330 or better steel, drilled hd. Screw, fill hd NC thd., 2330 or better steel, drilled hd. Screw, flat hd. NC thd. Screw, flat hd NF thd Screw, round hd. NC thd Screw, round hd NF thd	Sizes from #0 to 3/8 varying with type of screw	First dash no. gives screw no. or dia. in 16th, followed by 16. Second dash no. gives length in 16th. A replaces first dash if fillister head is not drilled. B means brass, and D aluminum alloy. Examples: AN510D6-8 is NF thd, alloy flat hd. screw #6 size, 8/16 long. AN515B416-20 is NC thd., brass round hd. screw, 4/16 dia., 1 1/4 long.
AN525	Screw, washer hd.	#8, #10, 1/4, length, to 2	Same as above screws, except no brass.
AN526	Screw, button h.d.	#6, #8, #10, 1/4, length, to 3	First dash no. gives size and tpi. Second gives length in 16th. C replaces dash for corrosion resistant steel, DD for alloy. Examples: AN526C632-4 is corrosion resistant screw, 6-32 thd., 4/16 long.
#530	Screw, sheet metal Parker Kalon type	#4 to #14.	First dash no. is screw size, second is length in 16th.
#531	Screw, sheet metal flat hd.	Same as #530	Same as #530
AN545	Screw, drive, rd. hd.	00 to 14 comm'l	Same as #530
#560	Screw, sq. hd. set	1/4 to 1/2	First dash no. gives dia. in 16th. Second gives length in 16th. Type letter replaces first dash. A for flat pt. B for cone pt. C for dog pt. D for cup pt.
#565	Screw, headless, set		Sizes, rule and types as no. as for #560.
#566	Screw, headless set, with screwdriver slot	#2 to #10 NC thd	Same as for machine screws. Points as #560
#650	Tag, identification	1 in. to 2 1/2 long	Dash no. gives length in 1/2s. Example: #650-4 is tag 2 in. long.
#660	Terminals, electrical	25 to 425 amps	No code
AN661	Terminal, spark plug safety lock	Standard	No code
AN665	Terminal, tie rod threaded type	1,200 to 76,000 lb	Specify if R or L thds.
AN671 to AN686 AN671A to AN686A	Tie rod, streamline, AC standard. Tie rod, streamline, SAE standard.	#6 to 1 in.	First dash no. gives dia. in inches plus 670, except #671 is #6, and #674 is #10. Second dash no. gives length in inches and 1st and 2nd decimals of an inch. Example: AN682A3050 is SAE standard streamline tierod, 3/4 dia., 30.50 in. long.

(To be continued)



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WHEN *salesmen ask you to buy clips and blocks which are supposed to be "just-as-good" as ADEL'S, ask 'em for proof. Remember, these precision-built line supports have been combat tested in United Nations aircraft an every fighting front. Nearly 10,000 production types and sizes available. Millions in use since 1937 by every major American and Canadian aircraft company. For free catalogs and complete information on the correct supports for electric conduits, fuel, oil instrument and hydraulic lines, contact nearest engineering service office.*

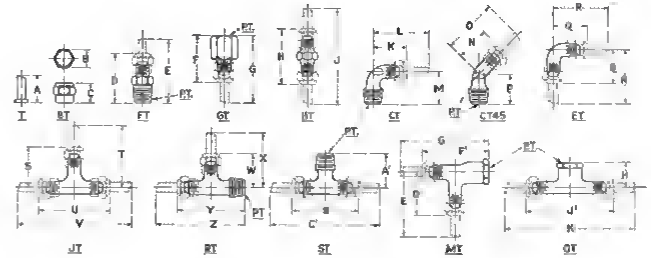
S*PORTY—is composed of standard ADEL line supports and ADELITE synthetic rubber material—all except the droopy drawers! ADEL line supports are manufactured under United States Letters Patent Nos. 2,222,283, 2,227,528, 2,279,865 Other United States and Foreign Patents Pending. No permit on his drawers but Walt Disney has 'em copyrighted!

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Air Corps Standards

Tube Fittings AN811



Dash Numbers	Brass Al Alloy Cop Sil. Ni Steel	2 2D 2CS 2NS	3 3D 3CS 2NS	4 4D 4CS 4NS	5 5D 5CS 5NS	6 6D 6CS 6NS	8 8D 8CS 8NS	10 10D 10CS 10NS	12 12D 12CS 12NS	14-12 14-12D 14-12CS 14-12NS	15 15D 16CS 16NS	20 20D 20CS 20NS	24 24D 24CS 24NS
Tube Size		1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1	1	1 1/4	1 1/2
Pipe Unk.		1/8	1/8	1/8	1/8	1/4	3/8	1/2	3/4	1	1	1 1/4	1 1/2
Sleeve * T	A	9/16	5/8	11/16	3/4	7/8	1 1/16	1 3/16			1 3/8	1 7/16	1 5/8
Nut * BT	B C	7/8 13/16	7/16 1 3/32	9/16 2 7/64	5/8 2 5/64	15/16 1 15/32	1 1 7/32	1 5/16 1 5/32			1 3/8 2 13/32	1 11/16 1 29/64	2 1/8 1 3/4
Nipple FT	D E	1 3/16 1 25/32	1 3/8 1 31/32	1 7/16 1 39/64	1 3/16 1 25/32	1 3/4 1 47/64	1 15/16 2 3/32	1 7/8 2 3/32	2 5/16 2 25/32	2 1/8 2 5/32		2 9/16 3 11/32	2 13/32 3 1/8
Connector GT	F G	1 1/32 1 27/64	1 1/16 1 31/64	1 1/8 1 7/16	1 3/16 1 29/32	1 5/16 1 31/64	1 1/2 1 15/16	1 31 2 3/64	1 29/64 2 23/32	1 21/32 2 13/32		2 1/2 3 17/32	2 61/64 3 3/4
Union * HT	H J	1 1/8 1 29/32	1 9/32 2 1/8	1 7/16 2 1/32	1 15/32 2 7/32	1 25/32 2 9/16	2 5/32 2 21/32	2 1/32 2 13/32	2 15/32 2 31/32		2 1/2 4 1/8	2 61/64 4 1/8	3 7/16 4 1/4
Elbow 90° CT	K L M	23/32 1 7/64 15/16	29/32 1 5/64 1	1 5/32 1 13/32 1 1/16	1 5/32 1 9/16 1 1/16	1 5/32 1 11/16 1 1/16	1 1/16 1 13/16 1 1/16	1 23/32 1 31/32 1 15/16	1 63/64 2 7/32 1 15/16	1 63/64 2 31 1 15/16		2 5/16 2 31/32 2 5/16	2 15/16 3 9/32 2 5/16
Elbow 45° CT45	N O P	63/64 1 21 1 5/32	1 5/32 1 21/32 1 3/16	1 5/16 1 25/32 1 7/16	1 7/16 1 15/16 1 5/16	1 11/16 2 1/16 1 11/16	1 15/16 2 5/16 1 15/16	2 5/16 2 13/16 2 1/16	2 11/32 2 31/32 2 1/16	2 13/32 2 11/32 2 1/16		2 15/16 3 5/32 2 15/16	3 7/16 3 21/32 2 15/16
Elbow * ET	Q R	63/32 1 7/64	2 7/32 1 17/32	2 15/32 1 15/32	2 15/32 1 31/32	2 15/32 1 29/32	2 15/32 1 7/16	2 15/32 2 1/16	2 15/32 2 1/16		2 15/32 2 29/32	2 15/32 3 1/4	2 15/32 3 1/2
TEE * JT	S T U V	2 3/32 1 61 1 7/16 2 1/2	2 1/2 1 17/64 1 11/16 2 1/32	2 1/32 1 15/32 1 45/64 2 5/16	2 1/32 1 9/16 2 1/64 3 1/16	2 1/16 1 23/64 2 1/64 3 1/32	2 1/16 1 7/16 2 1/64 3 1/4	2 1/16 2 1/16 2 1/64 3 1/4	2 1/16 2 17/64 2 1/64 3 1/4		2 15/16 2 29/32 2 15/16 3 15/16	2 29/32 3 1/4 4 5/32 6 1/2	2 29/32 3 11/16 4 5/32 7 1/16
TEE Male Run RT	W X Y Z	2 3/32 1 61 1 7/16 1 13/32	2 1/2 1 17/64 1 11/16 2 1/32	2 15/32 1 29/32 2 1/16 2 25/32	2 15/32 1 31/32 2 1/16 2 25/32	2 15/32 2 1/16 2 1/16 2 25/32	2 15/32 2 1/16 2 15/32 3 3/16	2 15/32 2 1/16 2 15/32 3 3/16	2 15/32 2 5/16 2 15/32 4 3/32	2 13/16 2 29/32 2 13/16 4 15/32		2 29/32 3 1/4 2 13/16 4 5/16	2 61/64 3 11/16 2 13/16 5 1/32
TEE Male Side ST	A B C	1 11/16 1 1/64 2 3/32	2 1 11/32 2 13/32	2 1/16 1 15/16 2 25/32	2 1/16 2 1/16 3 1/8	2 1/16 2 5/16 3 5/16	2 1/16 2 5/16 3 5/16	2 9/16 3 5/16 4 1/8	2 9/16 3 5/16 4 1/8	2 11/16 3 11/16 5 1/2	*	2 5/16 4 3/16 5 9/16	2 5/16 3 5/8 7 7/16
TEE Male Side MT	D' E F' G	2 3/32 1 15/64 1 13/32 2 1/64	2 1/2 1 25/64 1 17/32 2 13/64	2 1/32 1 17/32 1 23/64 2 7/32	2 1/32 1 9/16 1 25/64 2 5/16	2 1/16 1 11/16 2 1/64 2 25/64	2 1/16 2 1/16 2 15/64 3 1/16	2 15/32 2 5/16 2 15/32 3 7/64	2 15/32 2 5/16 2 15/32 3 7/64	2 13/32 2 11/32 2 15/32 3 19/64		2 15/16 3 5/16 4 11/32 5 5/16	3 4 1/32 5 11/16 6 3/16
TEE GT	H' J' K'	2 1/16 1 15/32 2 19/32	2 1/2 1 13/32 2 25/32	2 15/32 1 15/16 3 1/32	2 15/32 2 3/16 3 1/16	2 15/32 2 1/2 3 1/16	3 2 13/16 4 1/8	2 15/32 2 25/32 4 5/16	3 1/32 2 25/32 4 5/16	3 1/32 2 13/16 4 5/16		2 15/16 5 3/16 4 1/8	2 1/16 3 1/8 4 1/32

* No pipe thread on these fittings
Sleeves shall be made from copper silicon alloy or nickel steel
Nuts and fittings shall be made of brass alum alloy or nickel steel
Nickel steel nuts, fittings and sleeves shall be used on all steel tubing and on steel tubing only
Copper silicon alloy sleeves shall be used with brass and alum alloy fittings only
Nickel steel parts shall be of 125 000 lb per sq in T S and cadmium plated spec AN-QQ-P-421
Aluminum alloy parts shall be anodized spec 08-20005
Inside fittings shall be free of globules of metal and foreign matter
Example of part no 811BT2D is nut, 3-piece tube fitting, alum alloy ¼ tube
Commercial product Must be equal to and interchangeable with products of Parker Appliance Co., Cleveland Ohio
Pipe threads in accordance with spec. 25028
Dimensions are approximate for drafting room use only
Note—Size 16 sleeve "T" unit, BT union "HT" elbow ET and tee JT are used with size 14-12 fittings.



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And teamed with men and mechanism, New Departure Ball Bearings are carrying the brunt of this job—reducing friction, keeping things cool, postponing wear and maintaining precise location of parts. In fact, New Departure has a major responsibility in the whole ball bearing war production program.



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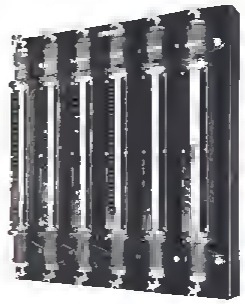
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There are several excellent reasons for the wide and increasing use of rotameter flow rate meters in the aviation industry. No other flow meter combines high visibility, instantaneous response, wide flow rate, even scale divisions and low pressure loss with high accuracy. The final impetus has come from the development of the patented Stabl-Vis rotameter by Fischer & Porter Company. It is the only flow meter that compensates for variations of viscosity and density in the fluid being metered. For further details, write for catalog 63-F on "Aviation Rotameters."

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For GROUND TEST WORK, we manufacture single or multiple tube rotameter panels for gasoline, diesel fuel, hydraulic oils, lubricating oils, Prestone, de-icer fluid, oxygen, air and many other fluids. The Stabl-Vis design that compensates for viscosity and density variations is a standard feature of these meters. Used by all of the major aviation manufacturing companies. If you will submit details of your flow test problem, we will gladly give you our recommendations.





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(Model) This armored Stabl-Vis rotameter is used for ground tests on high pressure hydraulic oil systems and accessories. Manufactured in a series of designs for pressures from 600 to 10,000 pounds. The only flow rate meter that will handle viscous fluids with high accuracy. Write for bulletin 63-B.

WEIGHT RATE TEST ROTAMETER

(Left) The Figure 12 Weight Rate Test rotameter combines the full features of the Stabl-Vis rotameter and measures liquid fuels directly in pounds per hour with its high accuracy unchanged by wide variations in viscosity and density in the fluid being metered. It is used by practically every manufacturer of aircraft equipment for measuring flow rates of liquids or gases.



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REMOTE READING FLOW METER

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DIRECT READING FLOW METER

The direct indicating Stabl-Vis rotameter is the standard of comparison for all fuel flow meters for use in airplanes. It is extensively used in Navy and Army planes. Excellent for flight test work also. Send for bulletin No. 300.



Rotameters for dieter fluid flow in two- and four-engine planes have individual floats which indicate visually the amount of fluid flow to each propeller or carburetor. They also have built-in needle valves for accurate control of the amount of flow. These meters conserve de-icer fluid and relieve the pilot's tension during the anxious moments when ice starts to form. The two-engine meter weighs 11 ozs.; the four-engine meter, 1 lb. 14 ozs.

Review of Patents

By A. HARRY CROWELL,
Registered Patent Lawyer

FOLLOWING are digests of some of the more interesting recent patents on aviation developments granted by the U. S. Patent Office. Mr. Crowell will gladly furnish readers with free information on approximate cost and procedure in applying for patents and trademark registration. Address inquiries to him, care AVIATION, 330 W. 42nd St., New York. Printed copies of any of patents listed are obtainable at a cost of 10 cents each, directly from U. S. Patent Office, Washington.

Hydraulic Control System for aircraft utilizes an electrical synchronizing gear designed to maintain automatically proper synchronism between pilot control and control surface.—2,317,270, filed Feb. 26, 1941, patented Mar. 30, 1943, R. W. Palmer, assigned to Vultee Aircraft.

Flying Boat Development provides special supporting and/or stabilizing floats which can be folded to form the bottom of the fuselage while the plane is in flight. Folded float is streamlined into fuselage contours.—2,320,574, filed Jan. 31, 1939, patented June 1, 1943, C. Dornier, vested in Alien Property Custodian.

Supporting Float for Aircraft. Float is of retractable wing type and is so constructed that it can be oscillated on its support and retracted along length of wing. This permits float to be folded between the wing beams. It is stated that the wing strength is not decreased.—2,320,597, filed Mar. 31, 1939, patented June 1, 1943, H. Hertel, vested in Alien Property Custodian.

Anti-Icing Duct. This invention provides a duct for exhaust gases, or other hot gases, to pass through the interior of leading edge of wing. Duct is made as a structural part of the wing and thus carries a part of the wing load. In this manner very little weight is added to wing.—2,320,870, filed Sept. 20, 1940, patented June 1, 1943, C. L. Johnson, assigned to Lockheed Aircraft Corp.

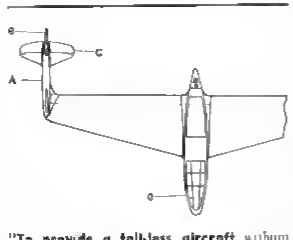
Mounting for Aircraft Components concerns aircraft retractable landing gear arrangement. There is a hydraulic system which, in the act of retracting the landing gear, loads a spring thus furnishing the power to extend the gear for landing. The spring, mounted within the hollow supporting arm of the gear, will extend the gear whenever the control latch is withdrawn.—2,321,065, filed Jan. 20, 1941, patented June 8, 1943, P. W. Burke, assigned to Dowty Equipment Ltd.

Rotative Winged Aircraft. The invention here is for a control and movement system for rotors of a dual-rotor autogiro. The rotors are mounted on arms extending laterally in relation to the fuselage, and the arms are adapted to rotate so as to tilt the rotors forwardly to provide transitional flight while maintaining the fuselage level.—2,321,572, filed Mar. 16, 1940, patented June 15, 1943, H. S. Campbell, assigned to Autogiro Co. of America.

Airplane Control Device. This development is particularly for the control of wing slots and flaps. The control arrangement is such that the slot covers and the flaps are operated simultaneously and are positively locked against any movement except when the pilot desires. Slot covers are further locked so that they cannot be moved under any circumstances until the flaps have been moved.—2,321,837, filed Nov. 12, 1940, patented June 15, 1943, F. R. Maxwell.

New Engine Control Means incorporates a combined throttle control governor for an aircraft engine and a variable pitch propeller controller. The engine controller is a speed-responsive governor which maintains the engine at a constant speed and the propeller governor is a torque-responsive device responding to the tork load of the engine in order to vary the propeller pitch.—2,322,303, filed Mar. 1, 1938, patented June 22, 1943, E. Martin, assigned to United Aircraft Corp.

Propeller Pitch Control. Here, invention is for a self-contained airplane propeller which has no outside controls for varying blade pitch. Instead, blade is varied from take-off position to flying position by inertia and aerodynamic forces operating against blade. Upon reaching flying position blade is automatically latched against further movement.—2,322,352, filed July 10, 1941, patented June 22, 1943, H. A. Frazier.



"To provide a tail-less aircraft without excessive inherent stability." Donovan R. Berlin has designed a pusher type plane with control surfaces on elongated booms *A* at wing tips. Rudder *B* and elevator *C* are controlled from cabin *D* so that rudders move in same direction while elevators can operate in same or opposite direction to act as ailerons.—2,326,019, filed Aug. 28, 1940, patented Aug. 17, 1943, assigned to Curtiss-Wright Corp.

Helgyroplane. This design (definitely on the implausible side) calls for a combined helicopter, auto-gyro, and conventional plane. Described is a rotor so constructed that its two blades may be locked laterally to act as conventional plane wings. The single engine would power the craft (1) with tractor propeller and rotor "fixed" as a conventional plane, (2) with tractor propeller and rotor idling as an autogyro, or (3) as a helicopter with engine geared to the rotor.—2,322,717, filed July 24, 1940, patented June 22, 1943, T. Kloeren.

Lateral Control for Aircraft. This patent is for a system to control the movements of lateral control air slot plugs so that the air slots in the two wings may be operated together or individually. In individual operation of one plug the other plug would be locked in a closed position.—2,322,745, filed Dec. 13, 1940, patented June 29, 1943, F. M. Rogallo.

Propeller Unit to prevent vacuum conditions at the rear of propeller hubs incorporates a tube having axial external screw fins. This tube is supported in the round stock of the propeller, and rotation of the propeller in turn rotates the tube, the fins then breaking the vacuum.—2,322,763, filed Jan. 8, 1940, patented June 29, 1943, W. Marthio.

New Servo System for aircraft employs a built-in pressure-responsive device in each control surface. It is stated that it will permit the weight to be appreciably reduced by obviating use of the conventional servo motor.—2,322,782, filed Jan. 13, 1942, patented June 29, 1943, A. B. Houstreet, assigned to Sperry Gyroscope Co.

Airscrew. This propeller is provided with a main-load bearing portion constructed of relatively heavy material plus a non-load bearing portion built of same cellular lightweight material. Named as suitable for latter are synthetic resins, expanded cellular rubber, and expanded cellular metals. Over all reduction in weight is stated to decrease the inertia centrifugal torque on propeller.—2,324,167, filed Aug. 21, 1939, patented June 29, 1943, F. M. Thomas, assigned to The de Havilland Aircraft Co.

Anti-Icing Construction. This patent features a system wherein heated air or exhaust gases pass through ducts located in critical areas of aircraft. Design is for ducts running through plane's movable control fins, and with lightweight construction it is stated that overall weight of control fins is not increased.—2,324,303, filed Feb. 25, 1941, patented July 13, 1943, Lockheed Aircraft Corp.

Simpler Landing Gear is reported through construction around pyramidal type truss arrangement so that retractable undercarriage requires less moving parts and is of lighter weight. There is said to be no sacrifice of strength, and arrangement for folding gear into wing is described as extremely compact.—2,323,367, filed June 10, 1941, patented July 6, 1943, E. M. Bertrun, assigned to Brewster Aeronautical Corp.





The Extra Passenger in a Wright Cyclone

Power per pound is the general criterion for aircraft engine valuation. Take-off power, size, life, reliability and altitude performance are important criteria but other things being equal there is no substitute for less weight. In Cyclone 9—powered planes the weight saving equals an extra passenger per engine.

Ten years ago, the Cyclone 9 weighed 1.2 pounds per horsepower. Since then, 600 HP has been added at a cost of only 420 lbs. in materials, cutting the weight ratio to .97 pounds per horsepower.



Cyclone crankshaft with Dynamic Damper

Wright engineering developments made this power gain possible. The Dynamic Damper for example, added 20 pounds weight but permitted an initial increase of 100 horsepower and opened the way to the present high ratings. Today's Cyclones use a steel crankcase which not only permits an other 100 horsepower increase but is actually lighter than the forged duralumin case. Tripling its fin area, the Cyclone cylinder now produces 150 horsepower in the same cubic displacement which developed only 83 horsepower in 1933.



Cylinder development 1933 — 1943

Thus Wright engineers have steadily extracted more and more power for smaller expenditures of material, so that today's Cyclone 9 is 13.5% lighter than any other engine in the same power class. This 13.5% means 175 lbs. advantage—or one passenger per engine—a payload bonus creating revenue dollars for the commercial operator.

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Fighting Line-Abreast

By J. L. LOWREY

One of the most successful fighter plane tactics used in the spectacular defense of Malta was line-abreast formation. Its flexibility for offense as well as defense is described here by a fighter pilot who flew with the RAF at Malta for six months.

A NUMBER of new combat formations have been developed in this war, and of these the most effective is the line-abreast formation used by single-place fighters, both offensively and defensively. The island of Malta was the real proving ground for this formation. It had been used in Germany and England by both the RAF and the Luftwaffe before the aerial blitzes on Malta made history, but its true development appeared in the air actions of the RAF in defense of the island against the fighter sweeps and bombing raids carried out by the Luftwaffe and the Italian Air Force.

As in all modern fighter formations, line-abreast has its basis in the pair system. Two aircraft assigned to fly together and act as a unit for mutual protection. A single aircraft in the combat area is useless, no matter how experienced or wary its pilot may be. It has been found that two is the largest number of fighters that has a hope of sticking together in heavy air action; even when flying in twos it's a commonplace occurrence for pairs to become separated if fighting becomes violent.

Accordingly, line-abreast formation is built up of two pairs of fighters, a total of four aircraft in the section. Number designations of the aircraft relative to their position in the formation vary in different air forces. I shall use the RAF number designation here. The formation consists of four fighters flying on the same level and in such a relative position to one another that a line drawn through the wing of any aircraft in the formation from tip to tip would, if projected, pass through the wings of the other three fighters. If you imagine four fighters at the same level, abreast of each other, flying with wide-spaced intervals, you have a picture of line-abreast as flown in combat.

Spacing between the aircraft of the formation varies with the duty assigned the group, personal preferences of the individual pilots, and the spacing desired by the leader of the formation. An average distance between aircraft is 200 ft. for spacing of the individual fighters in pairs and 250 ft. between the pairs themselves.

Using the British number designation for position, let's consider a line-abreast formation, and for the purpose of explanation, let us say that the section is flying north: The fighter on the extreme left, or west, of the section is No. 2, the next fighter is No. 1 (formation leader), the third aircraft is No. 3 (sub-section leader, this pilot taking over in case the leader is forced down), and finally on the extreme right or east of the formation is No. 4. Now taking the formation again. On the left Nos. 2 and 1 operate as a pair and on the right Nos. 3 and 4 comprise the second pair. (See Fig. 1.)

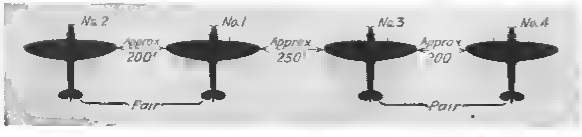


Fig. 1. Line-abreast formation. Generally it is made up of two sections of pairs—a four plane unit compact and easily controlled. The flight leader is usually in the No. 1 position, and the sub-section leader is in No. 3 position.

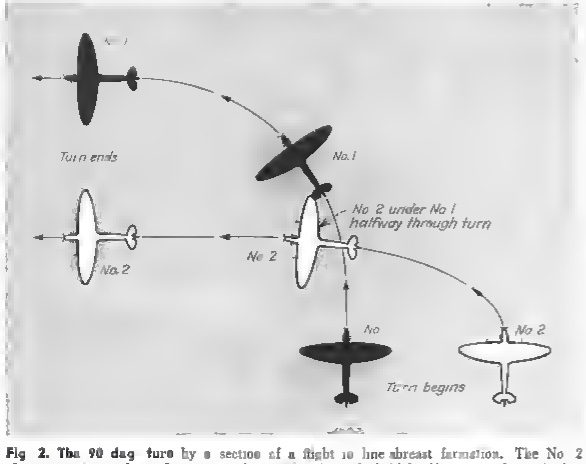


Fig. 2. The 90 deg. turn by a section of a flight in line abreast formation. The No. 2 plane, swinging under and assuming the position formerly held by No. 1, travels an farther than does No. 1.

One of the many points that make this formation an excellent one is its extreme flexibility and the rapidity with which turns can be executed as a group. In aerial combat a formation with which a cohesive turn can be made swiftly and with no danger of leaving some of the aircraft behind is an advantage that cannot be exaggerated.

A turn in line-abreast seems complicated and difficult on paper, but in the air it works very smoothly and is easy to learn. The maneuver is worked by means of cross-under turns, that is, the fighters cross under one another in making the turn. If this type of turn is properly flown the pilot doesn't have to use his throttle to keep his position. This means not only that gas will be saved, but that all the aircraft in the section will burn the same amount of fuel. There is no chance of one pilot running out of gas before the rest of the formation does, and the section leader will not overestimate the amount of gas left in the tanks of his other three aircraft.

Formation Turns

In analyzing the turn, let's use a pair. Two fighters are flying line-abreast—Nos. 1 and 2. No. 1, the leader, initiates the turn. Let's assume that he wants to make a 90 deg. change of direction to the left, and that his No. 2 man is on his right as the turn starts. The leader begins to turn and as he does so No. 2 starts a turn in the same direction, putting his nose down so that he will lose altitude in order to make his turn *underneath* the lead fighter plane.

Halfway through the turn, when both fighters have changed direction 45 deg., No. 2 will be directly, or almost directly, below No. 1. As the turn continues No. 2 will slide over to the left of the leader, and when the maneuver is completed No. 2 will have pulled up to his leader's level and again be in position line-abreast of his No. 1, but on the opposite side (the left). An alert pilot simply cannot be lost or left behind on this type turn. (See Fig. 2.)

In turning 180 deg., a complete aerial about-face, the procedure is identical as in a 90 deg. turn, with the exception that the No. 2 is in his original position relative to his leader after the turn is completed. Two 90 deg. turns are made. Still assuming that we have a pair of fighters making the turn, No. 1 initiates the move and No. 2 slides under. At 45 deg. of the turn No. 2 is underneath his leader, and at 90 deg. No. 2 is on the left of his leader in a line-abreast. As the turn goes on, No. 2 again ducks under his leader so that at 135 deg. (three-fourths completed) No. 2 is again below No. 1, and by the time the maneuver has gone through 180 deg. No. 2 is abreast his leader, on the same level and on the side he was flying before the turn began. (See Fig. 3.)

When four fighters are flying the procedure is the same. At the 45 deg. point of the turn all four aircraft will have "stacked" vertically, a compact unit, in the order of their formation position numbers—No. 1 at the top, No. 2 below, 3 below 2, and 4 on the bottom. In turns with a section of four, both the pairs and the individual aircraft will *reverse* their positions in a 90 deg. turn and end up in the *same* position after a 180 deg. change of direction. This assures that the section leader and the sub-section leader will always be in the center of the formation—on the inside, which is as it should be.

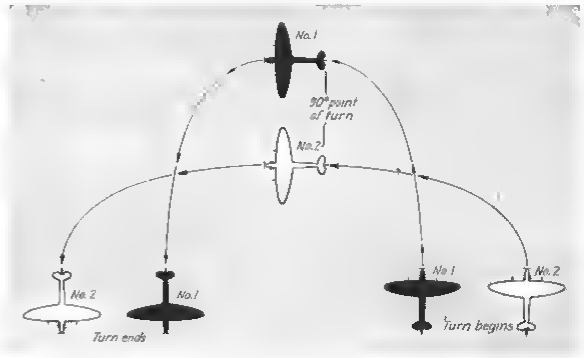


Fig. 3. The 180 deg. turn consists of two fully executed 90 deg. turns. Planes end up in same relative positions after turn is completed.

Combat Uses

In combat the formation is flown wide (at 200 and 250 ft. intervals) for a number of reasons. First, wide formation allows the individual pilots to search their assigned area of the sky without danger of collision. In a tight or closely spaced formation this would be impossible. In wide line-abreast the fighter pilot can get a good look around the sky without worrying about running into the aircraft next to him in the formation. Second, a wide interval allows individual weaving. This is usually

(*Turn to page* 314)

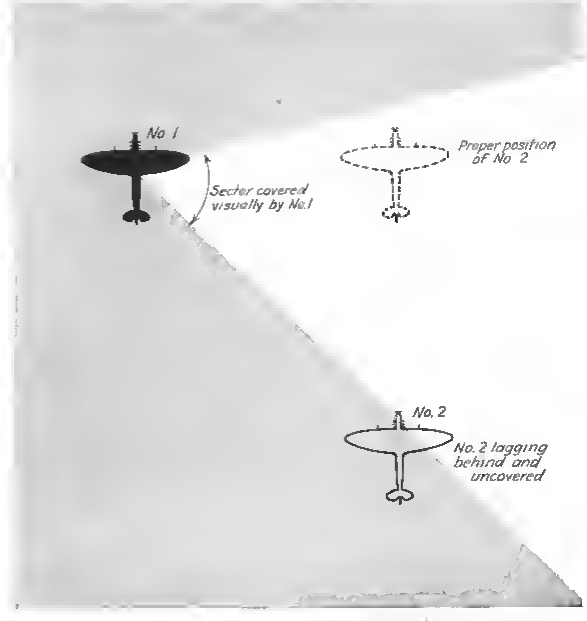


Fig. 4. A lagging plane endangers the entire formation by leaving blind spot uncovered. This plane itself becomes vulnerable, and it breaks up the area defense patterns assigned for all planes in the flight.



.50 CALIBER BABIES
Spit Bullets from Lightweight INSUROK CRADLES

Up thara in tha fora part of those wings, nestled snugly in gun troughs of FORMED INSUROK, are batteries of 50 caliber ma chine guns—tough babies that pack a wallop —that are rough on anything that gets near them.

Tough, too, are the troughs of INSUROK T-700. High impact strength lets them take tha beatings and be ready for more. Yet, even more important is tha weight reduction made possible by this versatile material. It saves priceless pounds wherever it is used.

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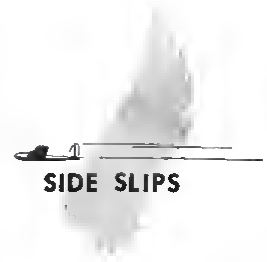
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SIDE SLIPS

SENATOR TRUMAN recently made a speech in which he forecast—with a few "if's"—a most rosy and prosperous future for us all. Among the items to help make the future rosy will be, he said, 100 hp, 100 lb, $100 plane engines. That price include a guarantee the engine won't "leak gasoline"?

• The other day high administration officials slapped the aircraft industry down for trying to get a little idea of what was in store in the postwar era. It wasn't a very subtle slap, either. The inference was only too plain, you lugs build airplanes, the planning will be taken care of for you. And what planning! For within a very short time the Labor Department announced a study which forecast 12,000,000 unemployed after the war. The solutions? Things that smelled very much like bigger and better WPA. The bright young men still seem to be with us.

• North American Aviation's President "Dutch" Kindelberger really started something with his rather amazing questionnaires in which employees really can—and do—take down their hair and say what they want. One comment certainly ought to provide a clue to keep employees from quitting—it might not boost aircraft production, but it would certainly solve the "manpower problem". This employee said, "of all the vice houses in America, Mr. Kindelberger, you operate the largest. Why not do something about that? Furthermore, I'll bet $10 that 'Dutch' Kindelberger, never reads this." We'll bet ten bucks the employee lost his $10.

• Trying to catch up at one fell swoop on reading our numerous English contemporaries we were struck by the constant plugging for superiority for British aircraft in every category, for every purpose. In fact, some of the plugs would have done credit to a Hollywood press agent.

Wasn't it an Englishmann—fellow named Shakespeara we believe—who said something about "methinks the lady doth protest too much"?

• Stepping in to the restaurant at a thoroughly modern Central American airport not long ago the first thing to greet us was a neatly printed sign saying "Please do not put feet on the tables or furniture." Turned out to be deadly serious and a touch necessary. That port was on a ferry route and the pilots stranded there for more than five minutes immediately assumed the American chair position—slumped way on the backs of their necks with feet up in the air. We weren't there long enough to see if the signs worked or not, but the place was spic and span and the food was good.

• Bullfesting with some pilots at an advanced fighter training base outside the country, Slide Slips felt very old and decrepit alongside the lieutenants, captains and even some of the majors. Checking 'round the circle we found they all had a right to vote, but one serious lieutenant summed it up beautifully when he said, "I'm 24, but I sure feel like an old man around here."

• A young fighter pilot getting his operational training at a southern base recently had to bail out. As he stepped out on the wing for his first parachute jump he was filled with a horrible fear. Not of jumping—he didn't give that a second thought—but of the millions of venemous snakes he visioned slithering through the slimy swamp to eagerly sink their fangs in him. He lived through it, but only after really "sweating it out" atop the broken plane as he awaited the crash crew.

He's overseas now. Where? At a base reputed to have more snakes per square foot of airport, hangar, and barracks than any two others in the world.

• Draft board medicos were once supposed to accept a draftee just by seeing if the body was warm. So desperate are aircraft manufacturers for manpower they'd eliminate even that test if they could.



"Moguire's out to beat Senator Truman's prophesied '100 hp, 100 lb, $100 engine'—and put it in a helicopter to boot."



© 1943 The Studebaker Corporation

Heading five miles high on engines that Studebaker craftsmen built

The whole world knows the war record of the mighty Boeing Flying Fortress. That devastating bomber gets its tremendous flying power from supercharged Wright Cyclone engines, large numbers of which are built by the famous master craftsmen of the Studebaker plants. Many of these men are fathers of younger Studebaker craftsmen now in uniform. In peacetime, these fathers and sons applied their talents to the manufacture of Studebaker Champion, Commander and President motor cars, as well as Studebaker trucks, for civilian use. Today, the members of the Studebaker working force are producing tens of thousands of big multiple drive military trucks in addition to Flying Fortress engines and other war matériel for the Allied fighting fronts. They'll keep at that task until victory permits them to devote their skill to the marvelously advanced new Studebaker cars and trucks of the better days to come.



Studebaker war trucks are serving the wide world over—Studebaker is one of the world's largest builders of big multiple-drive military trucks. With that equipment, plus Flying Fortress engines and other war matériel, Studebaker is playing a part in helping our Nation and its Allies win decisive victory.

★ BUY U. S. WAR BONDS ★

Awarded to Aviation Division of The Studebaker Corporation

Studebaker BUILDS WRIGHT CYCLONE ENGINES FOR THE BOEING Flying Fortress



Buy War Bonds and Stamps

No Achilles Heel

This slashed-in-two Flying Fortress* theoretically should not fly. There had been stiff fighter opposition. In the melee, a Messerschmitt, crazily out of control, crashed into it.

The German plane was destroyed on impact. The Fortress' fuselage was ripped diagonally from top to bottom. Control surfaces were carried away. The tail gunner, suddenly imperiled in his wabbling section, crawled forward over the narrow floor structure that held the parts together. And the Fortress flew steadily for an hour and three quarters—back to her base for a perfect landing!

Often the question is asked about Boeing Fortresses: *"How can they do it?"* One Fortress came home with 2000 bullet holes, and with big areas of both wing sections shot away. Another had a hole in the fin "large enough for the navigator to walk through." Others have come in with rudder and elevator controls sheared by gunfire.

How can they do it?

One reason is Boeing design. The Fortress has no Achilles heel, no highly vulnerable spot for the enemy to attack. No single structural member has to carry the entire load for its section, even when large portions of the plane are badly damaged, the Fortress usually is strong enough to remain aloft, fight off its enemies, and return home.

There are other reasons, of course—many of them. But they all stem from what has been termed the integrity of Boeing products. Soundly and conservatively engineered, honestly built, these products always have done more than has been expected of them. True today, it likewise will be true in peacetime tomorrow. . . if it's 'Built by Boeing' it's bound to be good.

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Air Transport Charts Routes To New Horizons*

By J. PARKER VAN ZANDT

"Which way?" and "How far?" are prime questions as operating figures and pertinent mail, express, and passenger factors are analyzed to gage air carrier trends in the coming decades.

FLYING INTRODUCES a revolutionary element into human affairs. It represents a fundamental revision in the ways of mankind. It is creating a three-dimensional consciousness, an awareness of the personal implications of flight on the part of millions of people throughout the world.

Our problem is to evaluate these changes as they appear due to affect the United States in 1950 or 1960—to indicate both the direction and the distance we may reasonably expect to advance under wise guidance during the next decade or two.

Total investment in scheduled flying operations in 1939 was roughly $150,000,000, of which our foreign and domestic carriers' own investment accounted for 45 percent, the Federal government's apportioned investment in airways for five percent, and airports for 50 percent. The global investment in both scheduled and non-scheduled flying in 1939 was about $438,000,000 three-fourths of which was in airports and one-third of which was assignable to scheduled air transportation.

Sixteen private airline companies comprise the bulk of the domestic air transportation system. Of these, the four largest carried, in 1940, four-fifths of the total cargo of passengers, mail, and express, one company alone accounting for 30 percent. The six smallest operators together handled only 2.5 percent of the gross traffic (see Fig. 1).

The financial structure of the air-carrier industry contrasts sharply with that of most rail transport companies. As shown by Table I, less than 10 percent of the combined airline capital is in funded debt, and less than 50 percent of total assets is in fixed assets (plant, equipment, and land).

Total domestic revenues from all sources were approximately $65,000,000 in the fiscal year 1940, an increase of 183 percent over 1935. Total revenues on the foreign routes were $20,000,000 in the calendar year 1939, an increase of 112 percent in the five years. Forty cents of each dollar received by domestic carriers went to salaries and wages; fuel took 9.4¢; insurance, depreciation, and other expenses accounted for 45¢, leaving 2.1¢ per dollar of income for net operating profit. The profit trend in 1940, however, was sharply upward, net operating income representing almost 10¢ out of every dollar earned.

There is considerable variation in unit fares among the domestic carriers and over different routes, the average ranging from 4 to 6¢ per revenue passenger-mile. On foreign routes passenger fares average about double domestic rates, or approximately 10¢ per mile. Domestic air express rates have changed little in recent years, averaging over 80¢ per ton-mile, or some 60 percent higher than equivalent passenger fares.

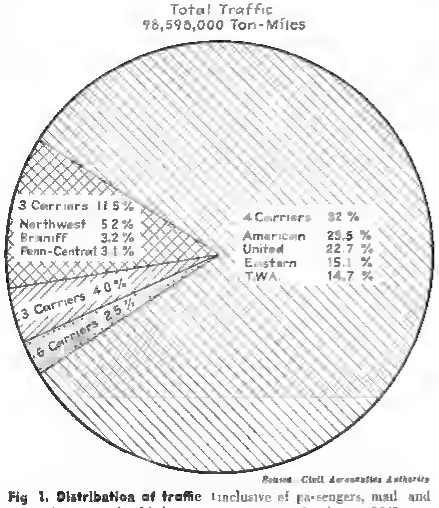


Fig. 1. Distribution of traffic (inclusive of passengers, mail and express) among the 16 domestic air carriers, fiscal year 1940.

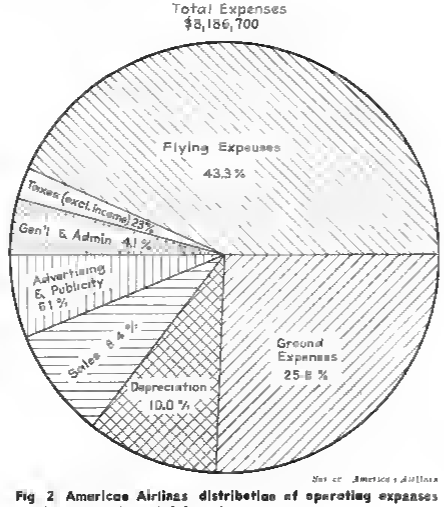


Fig. 2. American Airlines distribution of operating expenses for the six months ended June 30, 1940.

Operating Figures

On Dec. 31, 1939, all aircraft employed by the scheduled airlines were covered by passenger liability, public liability, and property damage insurance. The limits most commonly carried for passenger liability were $1,000,000 per aircraft per accident and $75,000 for any one passenger. With respect to public liability, the general limit carried was $50,000 per person, $100,000 per accident, and $50,000 for property damage insurance. The average premium paid by domestic carriers in 1939 was 1.33 mills per passenger mile for passenger liability insurance and 1.15 mills per plane mile for public liability and property damage insurance.



J. PARKER VAN ZANDT

Holder of Pilot License No. 11, Mr. Van Zandt is a Civil Aeronautics Board consultant and a contributor to AVIATION.

Air transport operation expenses may be divided appropriately into three general classes:

1. Those which vary primarily with the volume of flying and type of equipment;
2. Those which vary with the volume and nature of traffic handled.
3. The overhead and general administrative costs which, relatively, are little affected by moderate changes in either the volume of flying done or service rendered.

For a 21-passenger DC-3 employed 2,000 flying hours per year and wholly depreciated in six years (engines in 5,000 flying hours) these direct costs, excluding any interest on investment, amount to about 35¢ per revenue mile in current domestic operations. For a 40-passenger DC-4 cruising some 30 mph faster (220 mph) the significant cost computed on the same basis should approximate about 66¢ a mile. Intensity of use of equipment has a profound effect on significant costs. Double the utilization assumed above would reduce the direct cost for the DC-4 to the neighborhood of 55¢ per mile.

Obsolescence is still the primary cause for rapid plane write-off rather than actual depreciation.

Thus, the direct costs are now less than 2¢ per passenger seat-mile available on a number of domestic airlines; indeed costs are rapidly trending toward 1.5¢. It is probable that, within a reasonable future, the significant cost will approach 1¢ per pas-senger seat-mile on a capacity operation basis.

The question of overhead may be examined in terms of one of the major domestic air carriers—American Airlines—which in the last fiscal year performed some 30 million ton-miles of revenue service. As shown in Fig. 2, sales, advertising and publicity, taxes (excluding income tax) and general and administrative expenses together amounted to about 20 percent of the total operating cost. Hence, including overhead, a gross expense in the neighborhood of 2¢ per capacity seat-mile may be anticipated within a reasonable future.

Comparison on a plane-mile basis is not very helpful because a "plane-mile" is no more a definite unit of service than a piece of string is a unit of length. The most satisfactory common denomination of costs is the pay-load ton-mile. Fig. 3 (over) indicates a marked downward trend per pay-load ton mile earned, from 95¢ in 1935 to 59.5¢ in 1940.

Eastern Air Lines, one of the lowest cost operators, shows a unit expense of about 28¢ per pay-load ton mile offered[1]. A projection of the past five year trend suggests a unit cost of less than 20¢ per capacity-ton-mile within a few years. This is for gross operating expenses, including sales, traffic, advertising, administration, and overhead.

Catering to enhanced passenger comfort has worked against a reduction in unit pay-load cost during recent years. Together with other changes in operation practice, there may result an ultimate significant operating cost per cargo capacity-ton-mile approaching 5 or 6¢. To this would have to be added, of course, the airline's overhead, equivalent to perhaps 2-2.5¢ per capacity ton-mile as well as such pick-up and delivery expenditures as are inherent in handling cargo traffic.

TABLE I—FINANCIAL STRUCTURE OF THE AIRLINES

(In thousands of dollars)

	Domestic (As of June 30, 1940)	Foreign (As of Dec. 31, 1939)
Funded debt	64 439	$2,115
Preferred stock	565	
Common stock	21 321	7,393
Surplus reserves	64	1 681
Capital surplus	20 241	10 458
Earned surplus	−884	1 715
	45 748	23 362
Net worth	41 307	21 247
Total assets	90 495	90 355
Fixed assets in percent of total assets	45.3	46.8

1 Curiously enough, two essential characteristics of an air carrier are not reported to the government, namely, the ton-miles of transportation service both sold and unsold operated by a carrier during a given accounting period, and the proportion of these capacity-ton-miles actually producing revenue. While the capacity-ton-mile unit costs developed herein are derived from incomplete or inconsistently reported data, they may probably be considered as within 10 percent correct.

Mail and Express

Airmail revenue is still the backbone of the air transport industry. Indeed, it may be said to be the indispensable keystone in the airway arch, as without such assistance practically all the airlines would report substantial losses. This raises the question as to what would happen if the airmail surcharge were now to be reduced.

Non-local first-class mail in the fiscal year 1939 totaled some 70 million net ton-miles, of which about 75 percent involved a distance of 400 mi or more. If we assume that mail traveling 400 mi or more is ultimately expedited by air, this would mean an additional mail traffic to the air carriers of something over 50 million net ton miles. Adding the weight of containers at 10 to 12 percent the resulting gross mail traffic by air would be on the order of 70 million ton-miles—some seven times the present airmail volume.

The Post Office Department in 1939 paid the railroads for the transportation of all classes of mail some $100,000,000 of which approximately $20,000,000 was chargeable as first-class. If the volume of first-class mail forwarded by rail were reduced some 75 percent and the payments decreased in proportion, railroad receipts from the Post Office would only be reduced by 15 percent. Yet the great acceleration in first-class mail service by air might easily result (through expedited business turn over) in increased space requirements to handle additional second-, third-, and fourth-class matter. The direct loss to the railroads in first class mail revenue might be more than made up by an increase in other classes. There is also the possibility that an enhanced rate of exchange of business correspondence will stimulate the gross volume of business turn-over and thus will increase the amount of freight moving on the railroads.

Neither would Post Office gross revenues be adversely affected to an important degree by elimination of the surcharge and the transfer of three-fourths of all letter mail to the air. The average aggregate cost to the Post Office for the transportation of non-local letter mail and airmail combined is 49c. per ton-mile. If one-fourth of the existing letter mail were to continue to be forwarded by rail at current rates of postal compensation, the combined balance of first class mail and airmail could be hauled by air without additional cost to the Post Office at an average compensation to the air carrier of 52c per net ton-mile. First class mail would still yield the Post Office an average profit of $1.40 per ton-mile, or well in excess of $100,000,000 per year.

What precise postal compensation to the air carriers would be necessary for the transportation of 70,000,000 ton-miles of mail per annum would depend on various factors, principally on the number of additional routes and schedules that would be required, also on the average mail loads. During the fiscal year 1940, transport planes performed an average of about 30,000 mail ton-miles of domestic airmail service. The transfer of a substantial percentage of first-class mail to the air might increase the average service on primary routes to, say, 60,000-70,000 mail ton-miles per plane per year. In other words, about 800 to 1,000 transport planes would be needed to handle this alone.

This, however, is only part of the story. There are some 1,200 first-class and 3,600 second class post offices in the country. The former group produced, in 1939, 75 percent of the non-local first-class mail pound-mileage, the latter 12 percent. Yet on Apr. 22, 1941, there were only 330 scheduled or authorized airmail stops on domestic routes. Clearly, in order to service the mail properly, an "all up" mail policy providing next-day delivery to every important community in the country would require the development of a greatly expanded network of primary and feeder air routes.

The establishment of some 200 feeder routes contacting on the average 20 or more points per route would serve the originating centers for 90 percent or more of all non-local first-class mail. Such a feeder network might require the use of an additional 1,000 smaller planes.

The movement of commodities by air has lagged in America. Abroad, where the number of passengers flown is only a fraction of the high traffic in the United States, the volume of commodities moved by air is many times larger. Over here, in the fiscal year 1940, express represented only 3.1 percent of the total ton-miles of service performed, bringing in only 2.8 percent of the gross operating revenues of the 16 domestic airmail carriers. In that year, passenger business represented over $13,000,000, express $1,800,000.

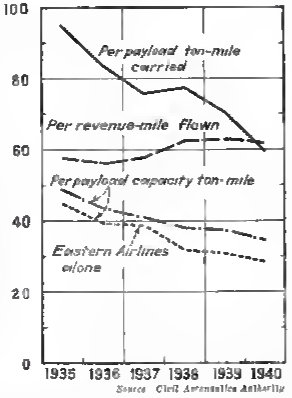


Fig. 3. Average unit operating expenses of the 16 domestic air carriers, fiscal years 1935-1940.

The present basic air express structure was established in August 1934, based on a charge of 4c a pound per 100 mi, with a maximum of 96c per lb. (But airmail, at 6c an ounce, also costs 96c per lb. Hence, above 2400 mi cargo may be set by air mail as cheaply as by air express.) For shipments of average weight traveling over 700 mi the air rate is from 6½ to more than 9 times greater than the first-class rail express rate. This may explain, in part, why air express has not developed as rapidly as other forms of air traffic.

Since the transportation of commodities is a competitive business principally on a price basis, some estimate of ultimate air freight rates is prerequisite to a decision as to what proportion of this business may ultimately move by air. Such an estimate involves a determination of the average load factor based on traffic flow, pick-up and delivery costs, and operating expenses, all of which can only be conjectural in advance of actual experience. Applying available data we find an average possible charge for air freight of 18c. or less per ton air mile. This is roughly equal, on an equivalent basis, to the present charge for first-class and parcel rail express shipments.

First class rail express traffic in 1939 represented approximately 750,000,000 ton-miles per annum. Hence, it does not appear unreasonable to expect that air freight, under favorable circumstances, ultimately may develop a traffic of some 500,000,000 to 600,000,000 ton-miles annually, representing a gross revenue in the neighborhood of $100,000,000. This would mean an increase of some 40 times the present gross air express receipts (including that presently deducted by American Railway Express) and an increase of about 200 times in the volume of air cargo handled.

Naturally, such a volume of business can only be realized through years of painstaking development and growth. It involves not merely the introduction of a fleet of low cost cargo planes but also the establishment of competitive commodity rates and their effective application by means of an integrated nation-wide service. On these premises and those already indicated in the pre-

(*Turn to page 305*)



The Columbia won every event in its class at the 1926 National Air Races. In 1927, Clarence Chamberlin flew it from Long Island to Germany. In 1930, Capt. Errol Boyd and Lt. Harry Connor flew it from Newfoundland to England.

4,000 MILES NON-STOP FLIGHT TO GERMANY



U. S. Army Air Forces Photo



Above: at Koethen, southeast of Berlin, where Pilot Chamberlin landed en route to Tempelhof Field, the Columbia gives this curious crowd something to think about. Below: the AT-21-BL gunnery crew trainer, now in production for the U. S. Army Air Forces.

This remarkable combat photo shows one of the unescorted B-17s in a fleet that rained destruction on the U-boat base and shops at Wilhelmshaven. Many of these powerful U. S. Army Eighth Air Force planes flew from America to England before they started their round-the-clock high level precision-bombing tasks over Germany.

Here is the answer to all Germans who thought America was "too far away." Had the Nazi leaders been a little brighter, they might have feared us sooner. Sixteen years ago, in 1927, a clear sign of American air prowess appeared in the German skies. It was the famous Bellanca long-distance cabin monoplane which flew over 4,000 miles to Germany in 42 hours and 45 minutes, non-stop, setting a world's record.

Today, the Bellanca tradition marches on in the production of the AT-21-BL gunnery crew trainer—precision-built armament equipment—and aircraft components for many of the United Nations bombers that are fighting for freedom in every theatre of this global war.

KEEP ON BUYING U. S. WAR BONDS

BELLANCA AIRCRAFT CORPORATION

NEW CASTLE, DELAWARE



The WIAC ...helping free men for active duty, too

When considering the important contribution that women are making towards the war effort, don't overlook the Women's Industrial Auxiliary Corps.

Like their sisters in the service auxiliaries, these women workers in aircraft factories—and in practically every other type of war plant—are today doing many of the "tremendous trifles" so important to the construction of warplanes.

Here, American Flexible Shielded Conduit is being made ready for final assembly into a medium bomber built by a prominent Eastern plane builder. Threading electrical wires through the conduit and soldering on end connections was formerly done exclusively by men. Today, however, with a minimum of training, women are doing the job equally as well, and in many cases, faster.

American Flexible Low Tension Shielded Conduit is used by every combat plane builder in this country. Hundreds of feet of this material in sizes ranging from $\frac{1}{8}$" in diameter to $2\frac{1}{2}$" in diameter shield the electrical wiring system so that radio interference is eliminated and signals clearly heard.

Allied with this line of Shielded Conduit, made to both Army and Navy specifications, is American's complete line of Shielded Conduit End Connections and Fittings for use in the electrical system. Fittings in accordance with AC, NAF and AN specifications are constantly rolling out of American's machines in larger and larger quantities.

American also makes flexible tubing in stainless steel and aluminum for use as hot air ducts and for conveying exhausts on planes, as well as a complete line of flexible metal connections so vital to the continued maintenance of the modern aircraft plant.

Our Technical Department will gladly assist with your particular problem.

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BUY ALL THE BONDS YOU CAN AFFORD — TURN IN ALL THE SCRAP YOU CAN FIND

CRUISE CONTROL For Flying Efficiency

Part IV . . . The Cruising Power Chart

By
R. DIXON SPEAS, *Asst to Vice-Pres Engineering*
JERE T. FARAH, *Chief Flight Analyst*
SANFORD HINTON, *Flight Analyst*
American Airlines

Further methods of cruise-control chart construction and use, including allowances for instrument and installation inaccuracies.

SEVERAL VARIABLES determine the conversion required to obtain actual speed of the airplane from the reading of the airspeed instrument. These variables, which directly bridge the gap between actual speed of the airplane and the airspeed instrument reading, are as follows: 1. Air density, 2. Instrument error, and 3. Installation error.

The effect of air density on the airspeed instrument reading can be clearly understood when its basic principles are understood. All present day airspeed instruments consist of two units, as illustrated in Fig. 1.

a. Pitot tube, mounted in air stream. The pitot tube is, of course, a conventional means for determining "mass flow" of a flowstream (air, gas, or liquid). This determination is accomplished by measurement of the dynamic pressure in the flowstream.

b. Airspeed indicator, mounted in cockpit. The airspeed indicator is a simple instrument for indicating pressure differentials. In the case of airspeed it indicates the difference between static pressure (measured at *A* in Fig. 1) and dynamic pressure plus static pressure (measured at *B* in same figure). This differential is then the existing dynamic pressure (dynamic pressure, plus static pressure, minus static pressure, equals dynamic pressure).

Dynamic pressure, as has been said, is a direct indication of mass flow of air. The dial of an airspeed indicator is calibrated to read miles per hour of airflow when the air density is that of standard sea level conditions. Since the instrument is basically pressure operated, it is necessary to correlate pressure and airspeed. Dynamic pressure is defined as—

$$\frac{\rho V^2}{g}$$

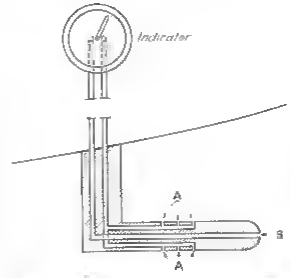


Fig. 1. Typical airspeed system with pitot tube and instrument.

where ρ is the mass density of the air in slugs per cubic foot and V is true airspeed in feet per second.

In this case, the dynamic pressure would be in terms of pounds per square foot, which is easily correlated to pounds per square inch. Thus, if standard sea level air density is used, pounds per square inch and velocity are directly related. (Pressure is proportional to V^2.)

Any pressure differential instrument with a suitable range could be converted to an airspeed instrument by calibrating the dial according to the above relationship.

When the air density is less than at standard sea level conditions, then the mass flow for a constant speed airstream will be indicated as less than if the airstream were at standard sea level conditions. The difference, it is found physically, is one which varies inversely as the square root of the density ratio (the ratio between the existing air density and standard sea level air density conditions).

Therefore, the airspeed instrument reading must be corrected by dividing it by the square root of the density ratio. Instead of laboriously making such a calculation, however, the procedure is done in practical fashion by either calculators or charts which have been so constructed as to do mechanically the calculation on the basis of existing density altitude (which directly determines existing air density) or existing air temperature and pressure altitude (which directly determines existing density altitude).

A chart which fulfills this purpose (shown in Fig. 2) allows the user to convert *indicated airspeed* (indicated airspeed is read directly on the airspeed indicator if there are no installation or instrument errors) to *true airspeed* according to the existing density altitude.

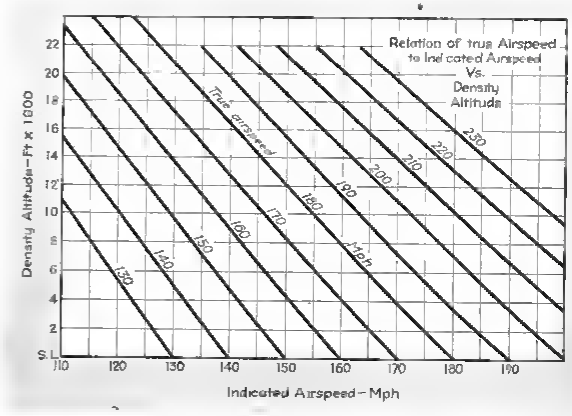
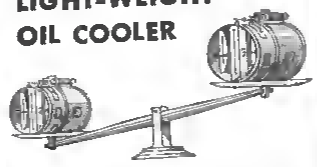


Fig. 2.

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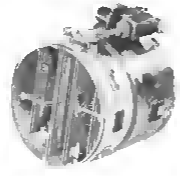


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For instance, from the example in Fig. 2 it can be seen that an indicated airspeed of 165 mph. under air conditions of a density altitude of 14,500 ft. indicates an actual airspeed (true airspeed) of 205 mph.

Second variable to be considered in airspeed corrections is the instrument error. This is caused by the mechanical imperfections in the pitot tube and indicator. However, improved design and manufacture have practically eliminated this error in present day instruments. Where it exists, however, it is accounted for simultaneously with the installation error.

Installation error is caused by air flow irregularities, as when the airflow over the pitot tube is not the same as the over-all airflow around the airplane. For example, an airplane may be flying through standard sea level density air at 100 mph., but the local airflow at the point where the pitot tube is mounted may cause the air to go by the pitot tube at 105 mph. Under such conditions—assuming no instrument error—the airspeed indicator would register 105 mph.

The above errors are determined by means of an airspeed calibration test. This may be accomplished by several different procedures:

1. Speed course runs where the actual speed of the airplane can be measured and compared to the airspeed indicator reading (after adjusting the airspeed indicator reading for the air density correction).

2. Use of a "trailing bomb" calibrated indicator. This device trails from an airplane in flight and measures the airflow in a relatively undisturbed strata of air below an airplane. The bomb is so weighted that it rides at a distance below the airplane at least equal to the wingspan. It is not always suitable at higher speeds because of a galloping motion which sometimes develops.

3. Formation flying with an airplane which has previously had its airspeed instruments calibrated by either of the above methods.

Regardless of the method used to determine the installation and airspeed errors, the information can be plotted from four or more check points, as shown in Fig. 3. The instrument reading can then be corrected to obtain the plane's actual indicated airspeed.

By the two individual correction methods which have been described, the airspeed indicator reading can be corrected to give the actual airspeed—true airspeed—of the plane. However, both corrections can be made by use of a chart such as shown on Fig. 4, which is derived from a combination of the charts of Figs. 2 and 3.

Terminology is extremely important in considering airspeed, and a short standardized glossary is offered for clarification:

Instrument Airspeed—Actual reading of airspeed indicator.

Indicated Airspeed — Hypothetical term which represents what indicator would read if there were no installation or instrument errors.

True Airspeed—Actual speed of airplane through air (obtained from instrument airspeed by corrections of air density, installation error, and instrument error).

Ground Speed—Speed that an plane actually makes over earth's surface.

Relation between airspeed corrections and the final cruising chart can be more clearly understood after considering other basic factors involved.

The basic curve relating power and airspeed is shown in Fig. 5. P_{1s} is plotted versus V_{1s}. This curve is simply a plot of power vs. airspeed for some standard weight and sea level density. If the curve of Fig. 5 is available for some weight and density, the curve of power vs. speed for any other weight and density may be determined from the following relations:

$$P = \frac{P_{1s}\,(W_a)^{3/2}}{\sigma^{3/2}}$$

$$V = \frac{V_{1s}\,(W_a)^{1/2}}{\sigma^{1/2}}$$

where P = Power at desired condition

$W_a = \dfrac{\text{Weight (actual)}}{\text{Standard weight}}$

$\sigma^{1/2} = \dfrac{(\text{density of air at desired altitude})^{1/2}}{(\text{density of air at sea level})}$

V = velocity corresponding to P at desired condition.

In Fig. 5, values for sea level and 24,800 lb. gross weight are shown. If power required for any speed, altitude, and weight are desired, the corresponding graph and corrections are made in two parts:

a. Altitude correction
b. Weight correction

Speed and corresponding powers for

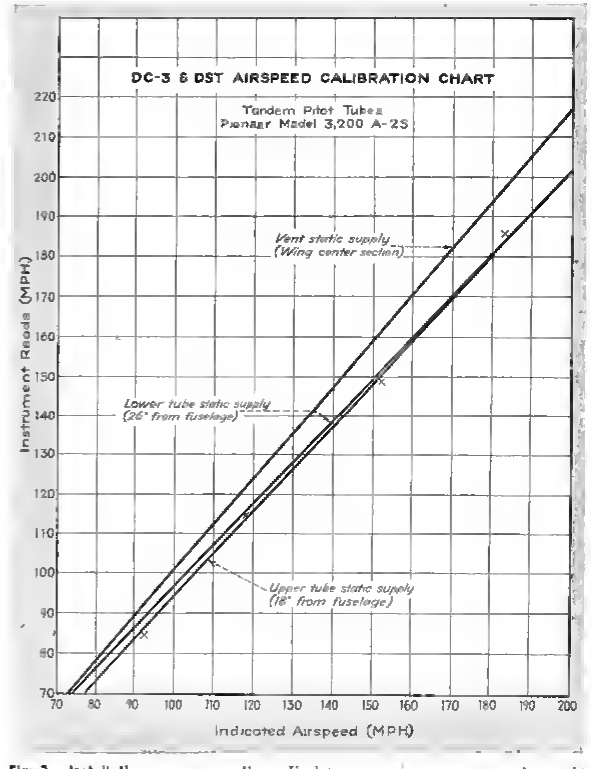


Fig. 3. Installation error correction. Used to convert instrument airspeed to indicated airspeed.

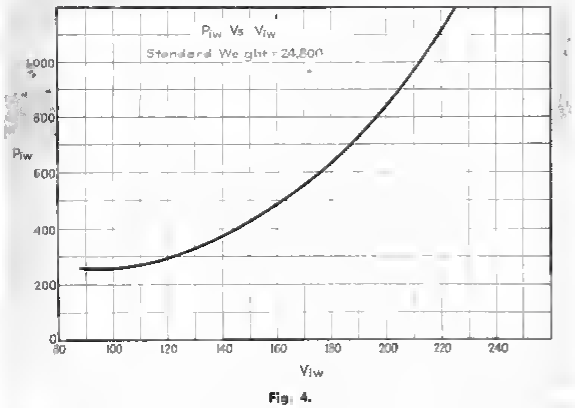


Fig. 4.

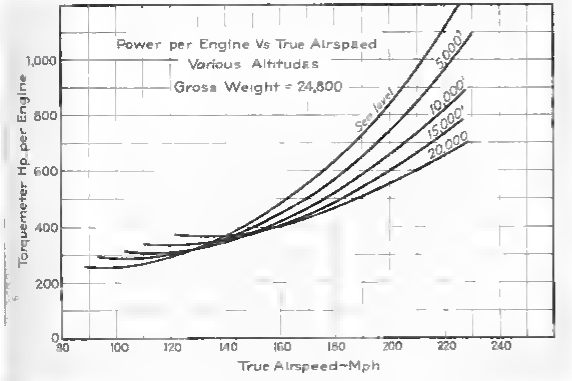


Fig. 5

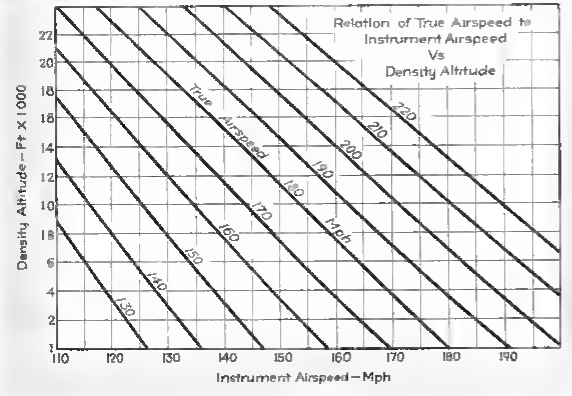


Fig. 6.

TABLE I—VARIATION OF VELOCITY AND POWER WITH ALTITUDE

Sea Level		5,000 ft.		10,000 ft.		15,000 ft.		20,000 ft.	
$\sigma^{1/2} = 1$		$\sigma^{1/2} = .928$		$\sigma^{1/2} = .859$		$\sigma^{1/2} = .795$		$\sigma^{1/2} = .73$	
V	HP	V	HP	V	HP	V	HP	V	HP
89	268	96	286	104	312	112	336	122	367
90	268	107	288	115	313	123	333	136	367
100	279	117	300	127	325	136	352	149	382
110	300	128	323	139	350	150	375	108	410
120	331	136	356	150	356	163	417	177	453
130	371	140	399	162	432	176	468	190	508
140	416	160	447	172	485	190	525	204	570
150	470	171	505	185	552	205	590	217	645
160	540	181	581	198	620	218	661		
170	621	192	668	208	723	225	784		
180	710	204	764	220	827	238	885		
190	816	214	880	231	955	250	1 002		

standard weights and density are shown in Table I (data taken from Fig 5) Only one variable at a time is changed, in this case density Values for sea level are taken directly from Fig 5 To obtain the corresponding true airspeed and power, the values of both P and V are divided by $\sigma^{1/2}$ Thus if at sea level $V = 89$ mph and $P = 268$ hp, then at 5,000 ft—

$$V = \frac{V_{sl}}{\sigma^{1/2}} = \frac{89}{.928} = 96 \text{ mph} \quad \text{and}$$

$$P = \frac{P_{sl}}{\sigma^{1/2}} = \frac{268}{.928} = 288 \text{ hp}$$

Similarly at 10,000 ft

$$V = \frac{V_{sl}}{\sigma^{1/2}} = \frac{89}{.859} = 104 \text{ and}$$

$$P = \frac{P_{sl}}{\sigma^{1/2}} = \frac{268}{.859} = 312 \text{ hp}$$

At 15,000 ft

$$V = \frac{V_{sl}}{\sigma^{1/2}} = \frac{89}{.795} = 112 \text{ and}$$

$$P = \frac{P_{sl}}{\sigma^{1/2}} = \frac{268}{.795} = 338 \text{ hp}$$

And at 20,000 ft.

$$V = \frac{V_{sl}}{\sigma^{1/2}} = \frac{89}{.730} = 122 \text{ and}$$

$$P = \frac{P_{sl}}{\sigma^{1/2}} = \frac{268}{.730} = 367 \text{ hp}$$

In each case V = true airspeed in mph and P = hp per engine at that altitude

As discussed above, the airspeed instrument in the cockpit reads correctly only at sea level (with the exception of instrument and installation errors). A study of the formulas above will indicate that the true airspeed is always—

$$\frac{\text{the speed at sea level}}{\sigma^{1/2}}$$

Instrument or indicated airspeed is true speed $\times$ ($\sigma^{1/2}$)— Thus at each of the altitudes shown above, the airplane instrument would read the same, and the true airspeed would be greater, as shown—

Examples just given are for only one point on the curve of P_{sl} vs V_{sl}. The steps are repeated for representative points, as shown in Table I. The values are then plotted as shown in Fig 6, where power per engine is plotted vs. true airspeed for various altitudes. This can also be plotted vs. indicated air-

(Turn to page 350)

Holley Carburetor Operating and Servicing

MAINTENANCE

By EDWARD E. THORP

Explaining a seemingly complicated device, to keep the engine working at its best even when conditions are at their worst

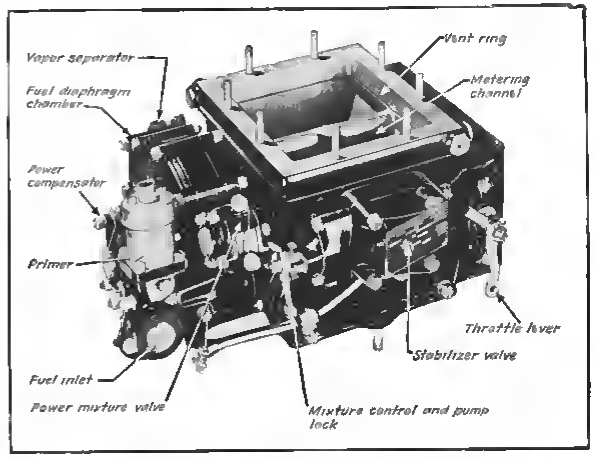


Fig. 1. The Holley automatic aircraft carburetor, Model H.

THIS CARBURETOR is made in several models all of which operate on the same general principles, the variations being in detail. The two models most commonly used on large aircraft engines are the Model F which has manual compensation for altitude and the Model H where this compensation is automatic. As both models are very similar, with the above exception, it will only be necessary to describe Model H

All models of Holley aircraft carburetors are equipped with variable venturi throttles, and they have several advantages for this type of work. First of all, icing is almost impossible, except under extremely bad circumstances, due to the complete absence of any throttle projections in the passages. In addition, since any increased throttle opening reduces the speed of the air flow through the throat, the carburetor becomes almost entirely self regulating except at higher than commercial altitudes.

Fuel Metering and Mixture Control

Fuel is supplied to the carburetor at a pressure of between 6 and 7 lb per sq in. It flows through the compensator venturi and the boil fuel valves and into the space between the main fuel diaphragms. When the fuel has reached the level shown in Fig 2., the pressure moves the diaphragms outwards, shutting off the flow of fuel as soon as the pressure (due to the depth of the fuel) is sufficient to overcome the force of the spring (not shown) which draws the diaphragms together. When the engine is in operation the entire space between the diaphragms and the space in the metering channel are completely filled with fuel. *During engine operation there is no fuel level.* The main fuel diaphragms serve only to regulate the pressure of the fuel and do not control the flow in any way. This control is via the metering pin, operated by the metering cam, which is connected to the throttle controls. The following two facts must be clearly understood and remembered. (1) The main fuel diaphragms regulate fuel pressure, (2) the metering pin controls fuel flow.

The vent ring, shown above the metering channel, is placed between the body of the carburetor and the air scoop. Its function is to supply all parts requiring atmospheric pressure with air at the average pressure of that entering the carburetor. For this reason its inside surface is perforated with a number of small holes so that points of local high or low pressure in the incoming air

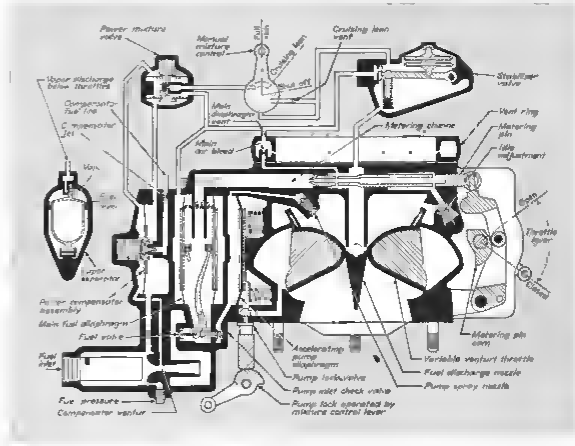


Fig. 2. Diagram of Model H carburetor.

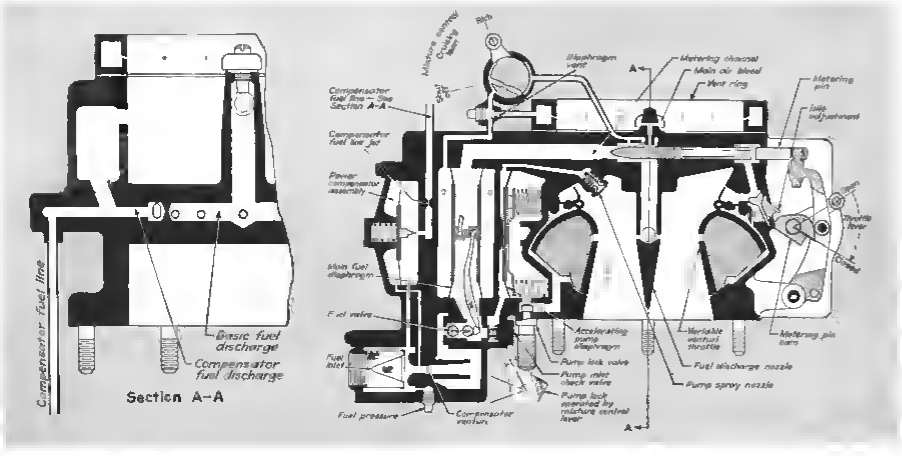


Fig. 3. "Full rich" position giving heavy fuel flow. Acceleration pump has emptied when throttles were opened. Needle valve is open, vent ring pressure is outside fuel diaphragms, and compensator is open.

stream will not affect the action of the carburetor. In high altitude engines, the pressure is that of the supercharger, instead of being atmospheric.

To Models "H" and "HA" the stabilizer valve has been added to provide automatic altitude, temperature, and load compensation. It is shown at the upper right of Fig. 2 and consists of a small slide valve controlled by two sealed capsules. Expansion of these capsules, from temperature or pressure changes, operates the slide valve which regulates the mixture ratio by changing the amount of air admitted to the various parts connected with it.

The vapor separator removes the fuel vapor and air given off by the fuel as the atmospheric pressure is reduced at altitude. The vapor separator is connected to the upper part of the main fuel diaphragm chamber. When vapor is formed in this chamber, the float drops, opening a passage to a point below the throttles, where the suction not only draws away the vapor but also causes the chamber to be refilled with fuel. Action of the float does not interfere with the work of the diaphragms, since they are operated only by fuel pressure, whereas the float is affected only by the height of the liquid or the presence of vapor.

If the carburetor were entirely automatic, with the exception of the throttle, the pilot would be unable to make any changes in the mixture which he might think advisable. To permit these changes, the manual mixture control has been provided. It consists of a small disk accurately lapped to fit its seat and provided with passages which permit the air pressure outside the main fuel diaphragms to be varied with regard to the suction at the metering pin. At "full rich" the connection between these two points is closed, resulting in a large difference between the pressure outside the diaphragms (vent ring pressure) and the strong suction at the fuel discharge nozzle, causing maximum flow.

At "cruising lean" the mixture control disk is moved 30 deg. from the full rich position so that the chamber outside the diaphragms is connected through the stabilizer valve to the suction around the metering pin. This reduces the difference in pressure between these two points, and the fuel flow past the metering pin is lessened, resulting in a leaner mixture. As the mixture control disk is moved farther from the full rich position it increases the capacity of the air passage between the main fuel nozzle and the space between the main fuel diaphragms, causing a further reduction in the pressure difference between these points so decreasing fuel flow.

Stopping

Finally, when the mixture control disk is moved 80 deg. from full rich, the pressure on the fuel at both the above points is equalized and no fuel flows, thus the engine stops. At the same time, the pump lock valve is closed by its cam (operated by the mixture control lever) retaining a full charge of fuel in the accelerating diaphragm chamber.

To assure a full rich mixture at higher powers, the power mixture valve is used. The space above the upper diaphragm is connected to the throat of the fuel compensator venturi, while that below the lower diaphragm carries fuel line pressure. When the fuel flow is increased, the greater suction from the throat of the fuel compensator venturi causes both diaphragms to compress the spring and move the valve which shuts off the air flow from the manual mixture control. Effect of this action is to give full rich mixture until the fuel flow is reduced, whereupon the power mixture valve resumes its normal open position.

Acceleration is accomplished by means of the accelerating pump diaphragm at the right of the main fuel diaphragm chamber. Normally, the space to the left of the diaphragm is filled with fuel, which flows from the main diaphragm chamber through the pump inlet check valve. The right hand side of the diaphragm is connected to the space below the venturi throttle, so that the suction from below the closed (or partly closed) throttles draws the diaphragm to the right and compresses the springs. This causes the diaphragm to draw in a full charge of fuel on its left side.

When it is desired to accelerate, the sudden opening of the venturi throttles reduces the suction behind the diaphragm to a point where it is overcome by the spring pressure, which forces the diaphragm to the left and sprays fuel through the pump spray nozzle until the springs have become fully extended.

The metering pin has a small hole in the point which supplies the fuel for idling. The amount of suction in the center of the metering pin is regulated by opening or closing the idle adjustment, which admits air from above the throttle to the metering pin. Closing the idle adjustment will result in a richer mixture, due to the increased suction.

At the left of the main fuel diaphragm chamber is the compensator diaphragm. The right hand side of this diaphragm carries the compensator needle valve and is under the same pressure as the fuel supply line. The space on the other side of this diaphragm is connected by a passage to the throat of the compensator venturi, through which the entire fuel supply to the main fuel discharge nozzle must flow.

When the flow is not high—as at cruising and low power—the compensator needle valve is held closed by the pressure of the spring behind it, because the difference in pressure between the fuel inlet and the compensator venturi throat is not sufficient to move the diaphragm against the action of the spring. When, however, the flow of fuel is increased, the pressure in the compensator venturi throat drops slightly as long as the fuel is flowing at the higher speed. This results in a drop of pressure on the left hand side of the compensator diaphragm, while the right hand side is still exposed to the full pressure of the supply line.

This pressure moves the diaphragm to the left and opens the compensator needle valve, admitting fuel to the compensator fuel line and thus enriching the mixture. Since the compensator spring is calibrated to operate at from 6 to 7 lb. fuel pressure *it is most important at higher powers to maintain this pressure on the fuel supply.* At the low power the compensator does not operate and so is not affected by changes in fuel pressure.

Installation

It is well to remember that to those unfamiliar with this carburetor and its operation, many engine performance defects may appear at first, to be faults of the carburetor.

There should be no looseness in the controls. The throttle and mixture control levers should have full travel with spare movement at the hand controls. The position of the mixture control lever for "cruising lean" should be clearly marked, halfway between "full rich" and "cut off."

All nuts holding the air scoop and its screen should be fastened securely. Gaskets should be used on each side of the screen and should be renewed each time the nut is broken. Air leaks at any part of the scoop will upset the balance of the metering forces and cause the mixture to be either too rich or too lean, depending upon whether the pressure in the engine compartment is higher or lower than that in the scoop. The joint between the carburetor and the engine adapter should be carefully

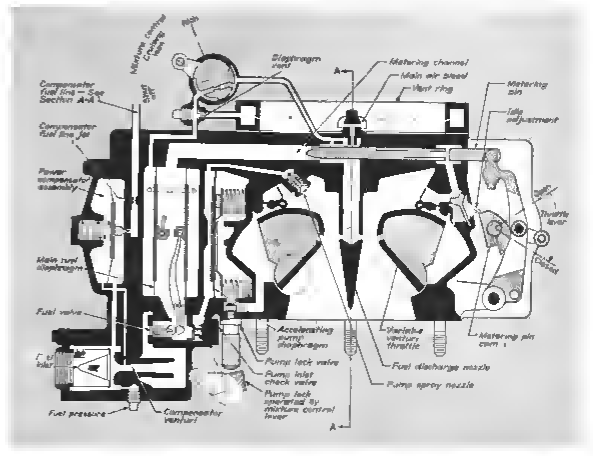


Fig. 4. "Cruising lean" position for medium fuel flow. Acceleration pump is partly filled, needle valve is half closed, and pressure outside fuel diaphragms has been reduced by nozzle suction. Compensator is closed.

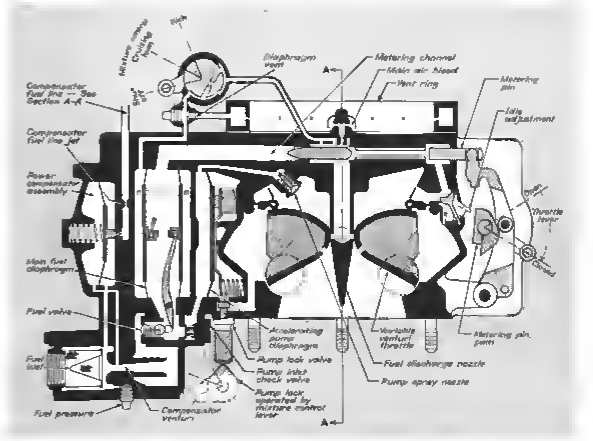


Fig. 5. "Shut off" position with no fuel flow. Acceleration pump is filled with fuel before shut off, pump lock valve closed. Atmospheric pressure is outside diaphragms. For "idle," throttles are opened slightly.

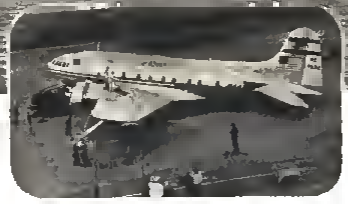
lightened and gasketed. Any leak at this point will cause the mixture to be lean, especially at low speeds. When running the engine on the test stand the air scoop should always be used, otherwise the slipstream from the propeller, crossing the vent ring, may cause pressures entirely at variance with those obtained under working conditions.

All unnecessary bends should be eliminated from the fuel lines, due to the danger of air or vapor locks. The system should be insulated against the heat of the engine compartment, which is a potential source of vapor trouble. On fighter aircraft the gravity type fuel selector valve will bleed air into the fuel system, if it sticks. This air lock has been known to make it impossible

(*Turn to page* 293)

America's International Airways Pioneer





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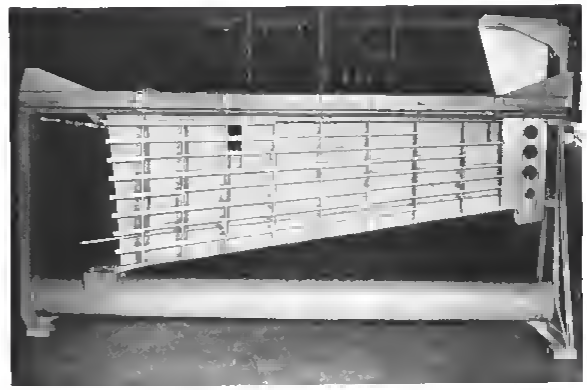
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MAINTENANCE

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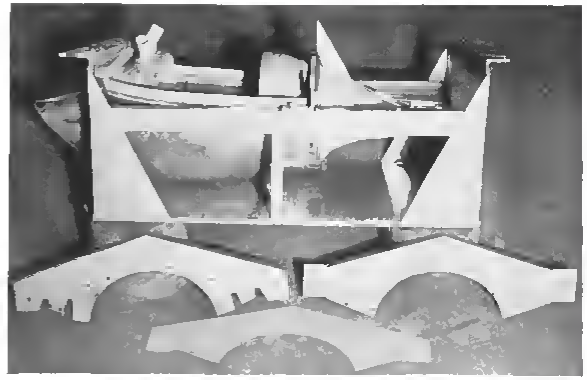
IN EVERY LIVE ORGANIZATION there is a guiding policy that can be recognized as the force which makes that company what it is. With Trans Canada Air Lines it is the department of engineering and maintenance—a department which is unique in combining the two functions under one head, giving equal importance to each rather than having one dominated by either the other or a less closely related division.

The reasons behind this are worthy of careful study, both for the results accomplished and for the men who set the machinery in motion. The original group has brought a close relationship between United Air Lines, Boeing, and TCA. A similarity of system between United Air Lines and TCA is unmistakable. The experience and achievements of Oliver West and P. G. Johnson (both former TCA men now with Boeing Aircraft Co.) in organizing the line are having their influence on manufacturing thought at Boeing just as surely as it was the other way around in the beginning. Problems encountered in airline operation are leading to new concepts indicating that the manufacturing field is the logical place to anticipate difficulties which should never reach the maintenance shop.

Circumstances combined to mold TCA's activities. A beginning with new and standard equipment contributed greatly to success. In starting from scratch the original organizers had the good sense and control to insist on six months of routine operational training flights to make all concerned thoroughly familiar with equipment and the country. Most of this initial flying was done on instruments to impress "hush" pilots with the importance of precision in scheduled airline work.

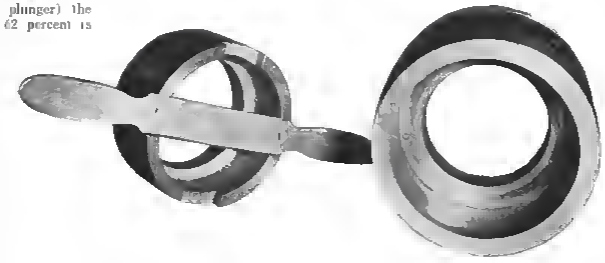
Although at first backing was half hearted and the revenue prospects were doubtful, national pride in the line and an advanced air-consciousness characteristic of Canada soon gave full support, which has since covered all costs and shown a profit in less than five years.

Conditions of climate have imposed problems of special and far reaching



This oil-cooler jig was designed by TCA for building unit in two parts separable at firewall, thus greatly facilitating removal at engine change.

Piston ring check fixture for testing accuracy of side contact. Application of bluing to ring shows (by imprint on fixture, seal, and plunger) the extent of contact. Minimum of 62 percent is required



nature which only operating experience and ingenuity could solve. This required a skillful blend of the aptitude and knowledge of veteran "bush" pilots and mechanics, plus an organization following standardized airline procedures prescribed for new all metal airplanes. It was not an easy conversion for men who had kept planes of odd types running individually for years in their own way. But after proper organization and with experience working in combination with good engineers, their record is hard to beat.

Most important influence was the war. In mid-development of the company, it cut off nearly all normal support in service and parts by the manufacturer of the aircraft. Result was that the engineering men had to make most parts and changes in order to keep the airplanes flying, and it was in every sense maintenance engineering from the start. Consequently the base at Winnipeg, Manitoba, is equipped for an extraordinary range of work, from maintenance and overhaul of ships traveling a 4,000 mi. line, to winterization, modification, redesign, and actual manufacture of many parts of the airplane.

Among the larger parts which could not be obtained were wing flaps, stabilizers, and elevators. To manufacture these, rigid steel jigs have been designed and built in the shop. For the wing flaps it was a complicated piece of work, due to the warp of this section, which had to be built into the jig. In connection with these flaps, a double problem was involved which is typical of many changes entailed by winter operation. To withstand the impact of slush and water at landing speeds the two inner flap sections on each side had to be built of heavier gage stock. For this a flap section jig was made up so that existing flaps could be strengthened and so replacements could be turned out for condemned units.

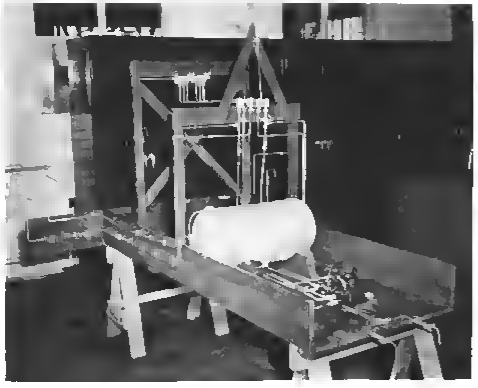
When the sections are built, they are united in the large jig which assembles the whole unit. Fortunately the flaps on both the Lockheed 14 and the *Lodestar* are interchangeable so that only one jig is necessary for both.

Streamlined splash guards on landing gear shock legs also raised a problem. If struck by ice at landing and takeoff, the lower portion was too easily jammed into the tire, causing dangerous cuts. These guards have all been shortened to avoid the danger, and the change has been recommended for northern-operating military craft.

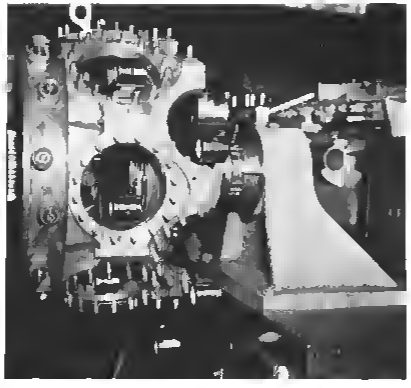
In spite of protective devices, ice slugs feed up under certain conditions, in which case they were more menace than ever. They have all been corrected, with landing technique standardized at slightly higher speeds without them.

The stream of improvements for winter operation is endless. The hot air heating system, designed for warmer climates, has been extensively altered with a new intensifier duct which runs clear of the rocker box, spark plug, and wires, instead of having these items mixed in with the tube, as was the case originally.

In addition, the mixing valve has been revised to give an even distribution of air to the cabin, and ducts have been led into the pilot's cockpit. The latest wrinkle, thought out by Shop Foreman McLeod—a man of countless practical ideas—is a system of spiral dimpling on the intensifier tube, instead of the common staggered placement. With overlapping spiral indentations, more air may be kept in longer contact with the heated walls to deliver a greater supply of hot air to the mixing valve.



De-icing system mockup which will standardize installations for all TCA planes. One central tank is used with a single type of fluid, with an auxiliary pump in case of failure. All leads run to cockpit control panel.



Crank shaft holding casting made in Canadian National foundry. Split inner section is tightened by screw lever, holding shaft in place for assembly.

A new carburetor air scoop has been built with an improved sliding shutter which is lighter than the original counterweighted device, and it will not ice fast, due to holes in the shutter which suck in warm air from the engine.

One particularly fine example of maintenance engineering is an improved design for the oil cooler scoop plus a jig to build it. The older type was of one-piece construction, so that when the engine was changed the whole air scoop had to be detached from the nacelle, although the cooler itself was forward of the firewall. The redesign builds the unit in two pieces, separable at the firewall so that the cooler comes off with the engine until the remainder of the scoop and rear fairing does not have to be disturbed.

Stripping and redesigning of the standard passenger seats has yielded a saving of 16 lb. per seat, which amounts to another passenger's weight on ten seats. The old base was discarded, the head piece removed, and a new lighter framework made up from the original material. In present form, ten seats can be removed for inspection in 35 min. Drawings for this design were sent in to Lockheed and have been incorporated in later models.

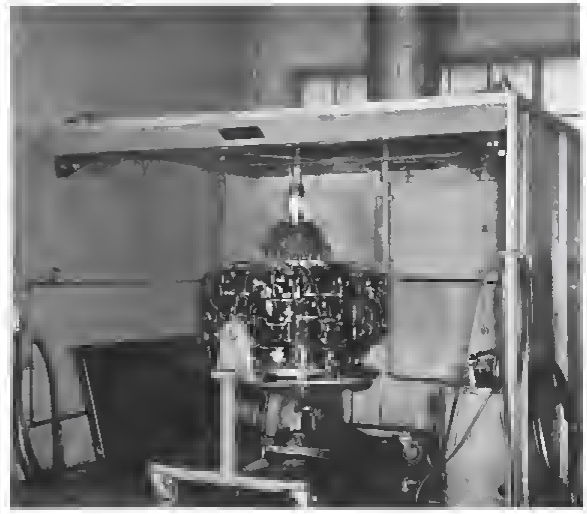
Greatest achievement was redesign of the Lockheed 14's to take the Pratt & Whitney twin-row *Wasp* in place of the *Hornet*. This involved complete restressing of the aircraft by Chief Engineer A. E. Ades, with provision to increase the gross load from 17,05 lb. to 1,805 lb., which actually gives a greater payload than before in spite of greater engine weight. The assets are a single type of engine to maintain throughout the entire system, and smoother and more reliable operation due to smaller power output per cylinder.

In engine overhaul not only those power plants used on company planes but also quantities of RCAF engines pass through the shop, to the number of about 100 per month. And the volume is still rising. They are almost entirely Pratt & Whitney *Hornets*, *H-Wasps*, or twin-row *Wasps*.

Engines sent in for overhaul arrive in crates and are unpacked in an outer room of the engine and accessories building. An overhead hoist raises them out of the crates and lowers them for mounting on disassembly stands, where engines are torn down for cleaning and inspection. Immediately adjacent are two rows of cleaning tanks, where all parts except those of cadmium plate are degreased, and painted parts are put through stripper tanks to remove the finish. Components of any one engine are tagged with identifying numbers to keep each set together.

Inspection follows thorough cleaning, with magnafluxing of all steel parts

(*Turn to page* 282)



Engine spray booth where assembled engines are prepared for limited storage. Engine assembly stand is modified Northwest Airlines design. It incorporates a rotating mounting ring which locks in any position. Frame turns from vertical to horizontal.



Propeller balancing stands made of steel beams sunk deep in concrete. Hardened steel round bars support mandrel are provided with screw adjustments for perfect level. Low mounting on posts eliminates all deflection.



Precision Built FOR SUSTAINED ACCURACY

The variety of work it handles . . the speed, accuracy, and safety of its operation place this new lathe in a class by itself. It combines compactness, economy and versatility. With its friction feed automatic apron and precise construction throughout, this new Logan Quick Change Gear Lathe is by every standard a rugged, highly adaptable machine of sustained accuracy. Bed ways, for example, are precision ground to within .001" of absolute accuracy. Total run out of the headstock spindle 12 inches from the bearing is less than .001". The lead screw is held to within .002" in 12 inches. All moving parts are protected by ball bearings or by self-lubricating bronze bearings. As for economy, the new Logan No. 820 quickly pays for itself through lowered unit costs.

LOGAN ENGINEERING COMPANY · Chicago, Illinois

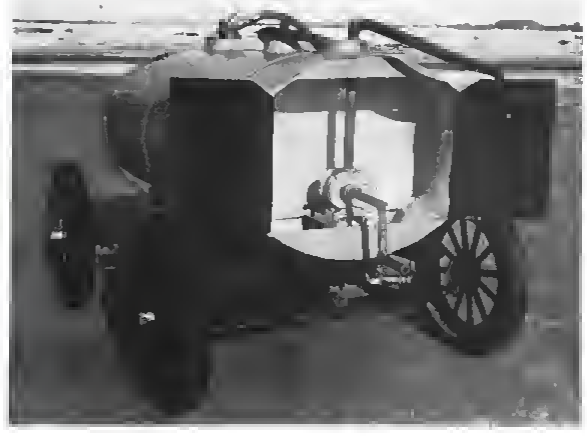
Brief Facts

- Swing over bed 10½"
- Bed length 43½"
- Spindle hole 25/32"
- Precision ground ways: 2 prismatic "V" ways, 2 flat ways
- 12 spindle speeds—30 to 1450 per minute
- Worm drive from lead screw spindle for power feeds
- Friction clutch on power feeds
- Longitudinal feed .0015 to .1006" per spindle revolution
- Cross feed .25 times longitudinal feed
- Half nut drive from lead screw thread for thread cutting

Threads—48 selections RH or LH—4 to 224 per inch

Logan

A NAME TO REMEMBER WHEN YOU THINK OF LATHES



AVIATION'S MAINTENANCE NOTEBOOK

Portable Heatable Oil Tank

• From the No. 2 Air Observer School in Canada, run by Canadian Pacific Air Lines, comes details of this handy oil tank and pump for outdoor servicing of planes where stationary pumps may not be available. To provide for winter use, an electric resistance heater with plug-in connection is built in under the tank, so that oil may be raised to any desired temperature before taking outside.

Construction is simple, embodying two front ends of the eternally reincarnated Model T Ford, with a frame and two cross members. Side members are 60 in. long, while the reach is 36 in. long and made of 2½ in. square oak. Tow bar, of 1½ in. pipe, 38 in. long, is hinged at the axle and extended beyond to tie into steering rod.

The tank itself holds 200 gal. and is equipped with inlet coupling and valve. When open, operation of pump draws oil from barrels into tank. With lower valve closed, same pump supplies oil from tank to plane.

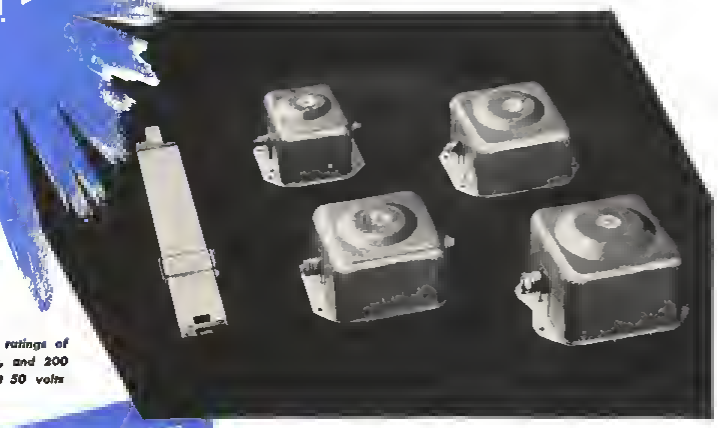


TCA Engine Parts Racks

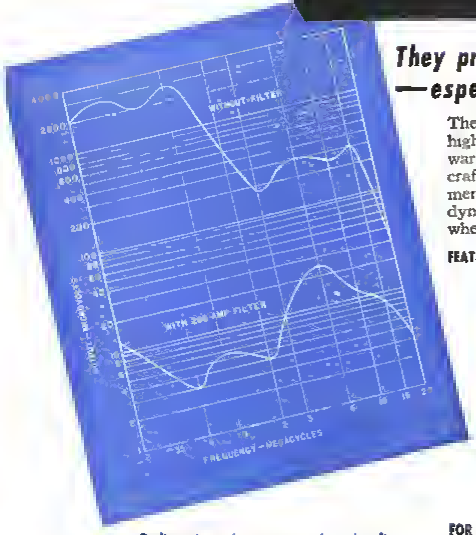
• Well spaced racks for all engine components are a great aid in engine overhaul. As soon as an engine is torn down, cleaned parts go on these racks for inspection and repair, with all units of any one engine kept together. Engine shown is a Pratt & Whitney twin-row 1,200 hp. *Wasp*.



NEW G-E RADIO-NOISE FILTERS for Aircraft



Available in ratings of 25, 50, 100, and 200 amp, d-c, at 50 volts



Radio-noise voltage measured on aircraft generator with and without G-E 800-amp filter

They provide excellent noise suppression —especially from 200 to 20,000 kc

These filters help immeasurably in providing the high-fidelity radio reception so important in aerial warfare. They attenuate radio-noise voltage on aircraft electric systems (on circuits with such equipment as generators, amplidynes, inverters, and dynamotors). They are particularly helpful in systems where open wiring is used to save weight.

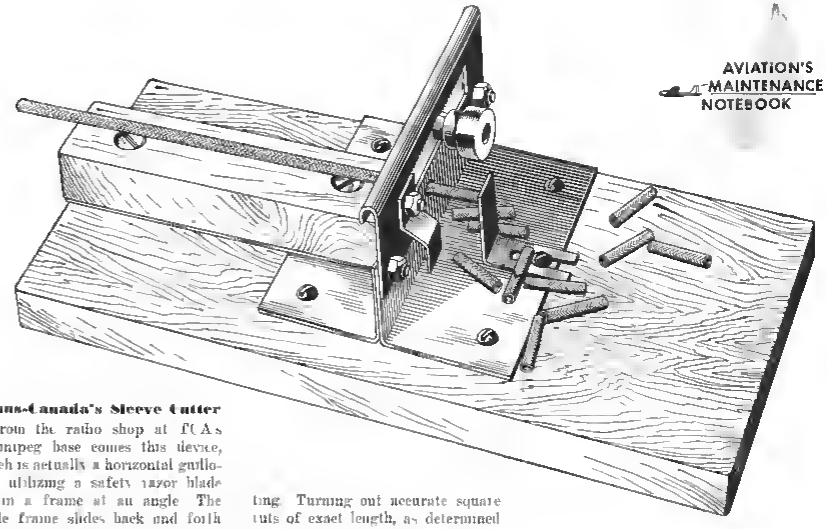
FEATURES

- **High attenuation characteristic results in excellent noise reduction**
- **Compact and lightweight (For 100-amp rating, shown in left foreground above, approx 2 1/5 lb, measuring approx 5 by 4 by 2 1/2 inches)**
- **Can be mounted readily in any position**
- **Operate efficiently over a wide temperature range (—50 C to 50 C)**
- **Comply with U.S. Army Air Forces specifications, including the stringent requirements as to vibration and acceleration**

FOR FURTHER DATA on these filters ask your G-E representative for Bulletin GEA-4098, or write to General Electric Company, Schenectady, New York.

GENERAL ELECTRIC

497-58-ATN



Trans-Canada's Sleeve Cutter

• From the radio shop at TCA's Winnipeg base comes this device, which is actually a horizontal guillotine utilizing a safety razor blade set in a frame at an angle. The blade frame slides back and forth by means of handle. Sleeve is inserted through a hole in the plate, which holds sleeve firm while cutting. Turning out accurate square cuts of exact length, as determined by adjustable stop set outside this unit makes a fussy job easy. It was devised by Roland Eades.

Can You Find Your Tools?

• A tool rack like this makes it easy, with a place for everything and many specific niches labeled. Bench is employed at Trans Canada Air Lines





"...fills a long existing gap in the aircraft engine industry."

Quoted from the letter of a leading aircraft engine manufacturer, the statement above is typical of the reaction in the industry to our new Aircraft Piston Ring Manual.

Illustrated here are several specimen pages as examples of the interesting presentation of authentic data. Pictures, charts and tabulations abound.

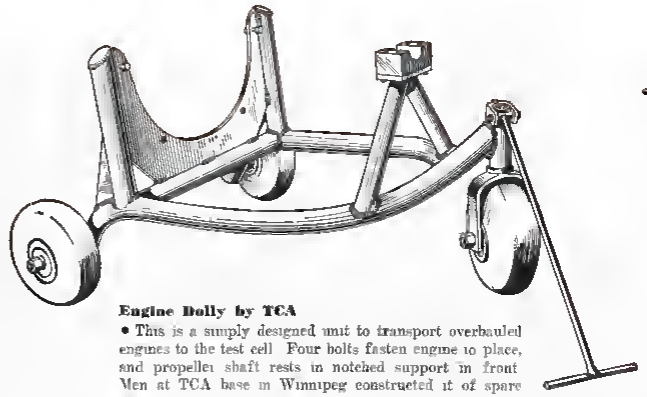
This Muskegon manual is available, without obligation, to all who are interested in servicing aircraft engines. In requesting your copy please state your position or activity which prompts your interest.

MUSKEGON PISTON RING CO.
Muskegon, Michigan
PLANTS AT MUSKEGON AND SPANTA

MUSKEGON
Piston Rings

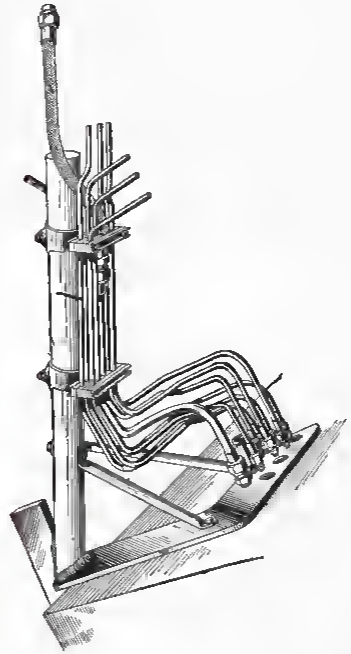
WRITE FOR YOUR COPY TODAY

AVIATION'S MAINTENANCE NOTEBOOK



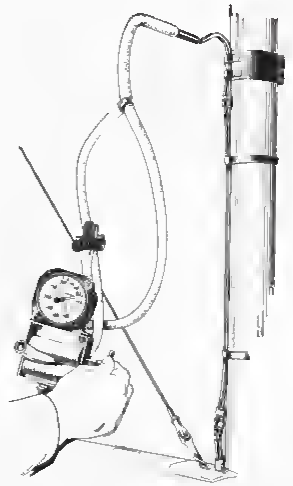
Engine Dolly by TCA

• This is a simply designed unit to transport overhauled engines to the test cell. Four bolts fasten engine to place, and propeller shaft rests in notched support in front. Men at TCA base in Winnipeg constructed it of spare pipe.



TCA Plumbing Jig

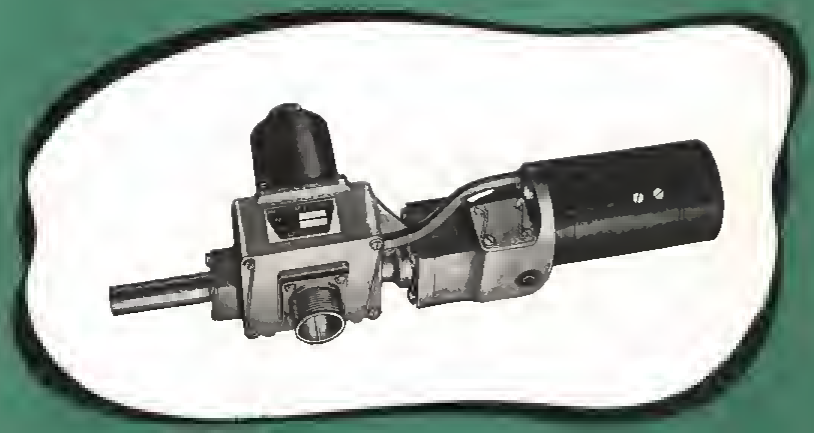
• To carry out standardization of all engine plumbing attachments and connections, Trans Canada Air Lines made up a positioning jig for preparation of new tubing. Corresponding locating fittings are incorporated in engine assembly stands, making plumbing installation quick and uniform. Devised at Winnipeg base.



Southwest Airways Airspeed Indicator Tester

• Built to check air speed indicators and their lines, this device will detect leaks in the valves, lines, or the instrument. Perfected by Southwest Airways, it consists of a previously checked airspeed indicator mounted on a handle, with a manual wringer and tubes for building up pressure. One end of tube is slipped over indicator outlet on wing and pressure is applied by turning wringer down rubber tubing. At each pressure point exerted, indicator in plane should match checked indicator on tester.

INTRODUCING



PACIFIC ACTUATORS

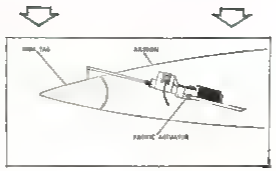
This little fellow makes the Bombardier's shots truer

Our new warplanes are rapidly eliminating all manual controls and here is one of the best new units to help in that job

It is a Pacific Model E-1156 trim tab actuator. At finger-tip controlled button the pilot regulates the action of his ship and keeps it perfectly steady on the bombing run. This small electric actuator takes over the manual task of operating the tab in elevator, aileron or rudder. It provides linear motion of 1½-in. on its shaft and will operate under tension or compression load of 450-lbs. It weighs but 4½-lbs. (approx.)

This is but one of many complete Actuator units built by Pacific Gear Works. Aircraft engineers can find among those already built, tested and flown, units which will handle any auxiliary power application in modern planes. These units are normally powered by altitude tested General Electric motors but can be supplied with hydraulic motors. Our engineers are ready to tackle any problem you bring us.

FOR OIL COOLER FLAPS



PACIFIC GEAR WORKS

DIVISION WESTERN GEAR WORKS

COMMERCIAL OFFICES AT: 11181 LONG BEACH BLVD., LYNWOOD, CALIF.

ASSOCIATED PLANTS, LYNWOOD, SEATTLE, SAN FRANCISCO

Grumman F6F "Hellcat" Scores in Combat

Photos of our Navy's new carrier- or land-based fighter released following craft's initial combat success at Marcus Island.

FLYING EQUIPMENT





First flight pictures of Grumman F6F *Hellcat*, Navy's "speediest, most maneuverable" fighter. Navy reports indicate *Hellcat*, with "its Pratt & Whitney engine and improved design, has emphatically indicated in its tests that it will, on equal terms, fight any fighter in the skies today."

KEPT WELL UNDER WRAPS even after the Truman Committee's report disclosed that it had been put into production, the Navy now has released general descriptions and photographs on the Grumman F6F *Hellcat*. The information followed successes of the new fighter during the recent carrier-borne raid on Japanese-held Marcus Island, 1,185 mi. southeast of Tokyo.

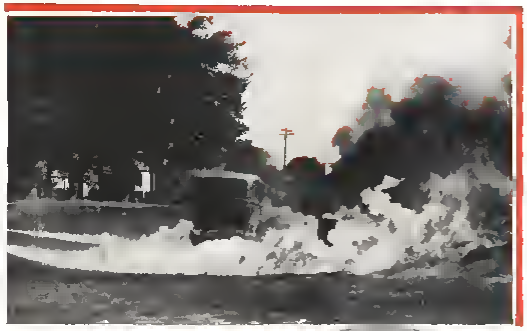
Except for the fact that the Pratt & Whitney powered F6F "is in the 400-mph class," is the Navy's "speediest, most maneuverable fighter," and is adaptable for either land based or carrier operation, performance and design details continued restricted, since none of its type has yet fallen into enemy hands.

In appearance, the F6F greatly resembles its predecessor type—the Grumman F4F *Wildcat*, which in the Pacific area has achieved a combat record of better than ten to one against Jap *Zeros* and bombers.



Close-up of Grumman *Hellcat*, which is adaptable for either carrier or land-based operations. It is termed an all-altitude fighter with exceptional maneuverability to highest combat ceilings.

600 LB. NOZZLE PRESSURE EXTINGUISHES FIRES FAST!



10 to 35 Times More Effective Than Low Pressure...Extinguishes 95% to 98% of Fires with Little or No Water Damage

High pressure atomization (600 pounds at the nozzle, 750 to 800 pounds at the pump) is the most modern and effective technique ever used in fire fighting. It is 10 to 35 times more efficient than low pressure — and as much faster. Will put fires out with little or no water damage. The FMC Fog Fire Fighter is effective on all types of fires including gasoline and other inflammable liquid fires.

High pressure "fog" from one gallon of water absorbs 10 to 35 times as much heat as same amount of low pressure water. Has extraordinary cooling and smothering effect, with tendency to blow the fire out.

Reduce Fire Losses . . . Equip with this Modern Protection! FMC Fog Fire Fighters are built in several models — light, compact, low cost — with power take-off units assuring ample power for operating the pump. Carries own water supply and complete equipment. Plan to modernize your equipment as soon as the war is over. Write John Bean Mfg. Co., 736 Hazel St., Lansing, Michigan or Bean-Cutler Division of Food Machinery Corporation, 436 Julian St., San Jose, Calif.



THERE'S NOTHING LIKE *High Pressure (600-800 lb.) fog for fast action on gasoline fires. The finely atomized, powerful fog has been proved on hundreds of gasoline fires.*

* * *

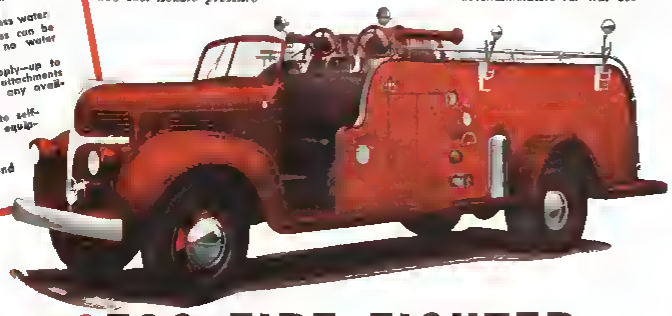
BEAN FIRE FIGHTER GUN *shows trigger-lock gun releasing close-up fog for closed area. The pump makes the pressure, the gun controls it. One man can fight fire with this gun, and can handle one ¾-inch hose easily.*

THE FMC *Fog Fire Fighter Truck . . . Equipment includes 300-gallon water tank, two lengths of hose and two Fog Fire Fighter Guns of 30-gallons per minute capacity giving 60 G.P.M. at 600 lbs. nozzle pressure.*

Manufacturers of high pressure crash trucks for gasoline fires and decontaminators for war use

7 BIG ADVANTAGES!

1. 10 to 35 times more effective and faster than low-pressure
2. Puts out fires with 90% less water
3. 95% to 98% of all fires can be put out with little or no water damage
4. Carries own water supply—up to 400 gallons, as well as attachments for taking water from any available source
5. Compact — complete self-contained fire-fighting equipment
6. Light weight
7. Low cost for all-around fire protection.



FMC *Original* **FOG FIRE FIGHTER**

FOOD MACHINERY CORPORATION

JOHN BEAN MFG. CO. DIVISION, 736 HAZEL ST., LANSING, MICH. * BEAN-CUTLER DIVISION, 436 JULIAN ST., SAN JOSE, CALIF.



The 'Game Goose' gets home . . . again

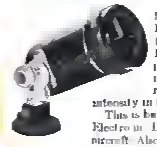
● **The old girl's done it again. She's laid her eggs where they'll count most—and in spite of hell and high flack, she'll soon be smoothing her ruffled feathers at home.** —The capacity of America's fighting men and machines to absorb punishment, as well as dish it out—to come back again, and again, and again—is no accident.

Electronic Laboratories is proud of the *E·L* equipment that is helping the 'Game Goose,' and every American fighting plane, get home again.

On every front where the United Nations are in combat, *E·L* Vibrator Power Supplies are proving themselves as rugged and reliable as the company they keep. At high altitudes, in steaming jungles or blazing deserts, they perform their appointed task with the greater efficiency and freedom from wear, characteristic of *E·L* Vibrator Power Supplies.

Wherever electric current must be changed in voltage, frequency or type, *E·L* Vibrator Power Supplies and Converters offer many definite advantages, for peace, as well as for war.





New E·L Lamp for Aircraft Instrument Panel Illumination — Provides ultra violet (black) or visible light. Operates on 28 Volts DC as E·L Voltage Doubler is available to permit operation from 12-volt systems. Adjustable iris eliminates necessity for a dimming rheostat, yet permits complete range of light intensity in both the ultra violet and visible light.

This is but one of several ultra violet lamps provided by Electronic Laboratories in E·L Black Light Systems for aircraft. Also manufacturers of E·L Vibrator Power Supplies for Black Light Systems for Radio Transmitters and Receivers, E·L Vibrators for Sperry Directional Compass and Visual Signalling Equipment for Aircraft.

Electronic LABORATORIES, INC.

INDIANAPOLIS

E·L **ELECTRICAL PRODUCTS**—Vibrator Power Supplies for Communications Lighting Electric Motor Operation Electric, Electronic and other Equipment on Land, Sea or in the Air



★ Berryloid Aircraft Finishes carry the fight to the elements . . . just as thousands of Berryloid-finished fighters and bombers are carrying the war to the enemy. For more than a quarter century, Berryloid Aircraft Finishes have had that aerial superiority that is finding its counterpart today on every war front. Post-war transport and other aviation users will have this same dependable protection.

BERRY BROTHERS, INC.

DETROIT, MICHIGAN • WALKERVILLE, ONTARIO

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BERRYLOID

AIRCRAFT FINISHES



NEW C.I. GARB

Standardized uniform for civilian instructors at AAF primary contract schools is modeled by Flight Comdr. Ralph Crocker of Hawthorne School of Aeronautics, Orangeburg, S. C. Similar to ATC attire, it is of all wool santan fabric like Army officers summer dress with shoulder patch for particular school. Wing emblem is lettered "Instructor"

Along the Apron

• CAB's study of a four-year recording of accidents resulting from malfunctioning and failure of engines of 90 hp. and less shows that more than half the mishaps could be traced to fuel systems. Of 1,731 accidents reported, 962 concerned fuel, and one-third of these were charged to mistakes by pilots. Undetermined causes were responsible for 403 or nearly one-fourth of the accidents. Failures in power plant structures, ignition systems, miscellaneous components, and lubrication systems accounted for 20 percent of the mishaps. CAB also reports a downward trend in non-air-carrier accidents during 1942.

While certified and student pilots increased from 175,828 to 222,280, accidents dropped from 4,251 to 3,324. Private flying troubles decreased (as pleasure flying was restricted) but there was a "slight numerical increase in fatal accidents in instructional flying." On the whole, however, "the fatal and serious-injury accident ratio decreased substantially." In July this year CAB received reports of 17 fatal accidents in non-air-carrier flying and one in scheduled operations.

• Graduate Division of New York University's College of Engineering has announced new courses in applied aerodynamics and helicopter theory . . . Following liquidation of NYA, four weeks' pre-factory training courses for prospective employees of Consolidated Vultee have been transferred to Will Rogers War Training School, Fort Worth. Chamber of Commerce and YMCA are helping find accommodations for 16-17½-yr.-old candidates. Convair is also enrolling engineers without previous aircraft experience in a part familiarization course leading to employment in design drafting and stress analysis groups.

On Patrol

• CAP's program to enlist AAF cadets, first assignment given by the War Department, "has succeeded beyond our most optimistic expectations," National Headquarters announces. Enlistment figures have not yet been compiled, but reports of various drives indicate that they will be large.

In one Tennessee community, for instance, preparations were made to handle about 100 candidates at a rally; 1,100 showed up. In other places, 17- and 18-year-olds were attracted by newspaper advertisements, meetings addressed by Army officers, pamphlets dropped from planes, and free 15-min. flights. Between the time of enrollment in the Air Corps Enlisted Reserve and induction six months after their 18th birthday, the candidates are being enlisted as CAP cadets for preliminary training in meteorology and aviation.

• "Detached flights," composed of a minimum of ten members or provisional members none of whom is required to be a pilot, may be formed in areas where there are no established units.

CIVIL OPERATION AND TRAINING

Procedure Announced For Obtaining Parts

Forms for obtaining repair and replacement parts for CAP planes in active service ("A" category) are being distributed through wings and regional WPB offices.

Official procedure is for owners to list, on WPB Form 1747, articles they estimate will be needed for maintenance or major overhauls. Requests should be specific, i.e. so many spark plugs, so much tubing or electrical equipment, a windshield of such and such dimensions. This information, together with plane number and ownership data, is filed with WPB Aircraft Priorities Branch, which issues a rating. The rating is presented to the service operator (like ration points) when the plane is brought in for repair, and it authorizes the issuance of the items requested.

Form 1747 may be filed by individuals or groups of owners. In emergency, WPB field men are authorized to issue PD1-A, usual form for obtaining parts under the Controlled Materials Plan.



DOUBLE-ACTION TRAINING

Simultaneous instead of individual training of cadets in instrument and radio range flying is made possible at Southwest Airways' RAF school, Falcon Field, Ariz., with this combined Link and AT-6 instrument panel. It was devised by Melvin K. Lyster (above) who instructs over same beam carrying range signals and at same time demonstrates a problem on blackboard. Correct course can be indicated by manipulation of panel instruments.



THUNDERBOLT'S OWN BACK YARD!

MILITARY airmen know that this is the day of *specialized* planes . . . designed to do specialized jobs. Some planes are best for ground-strafing . . . others for medium level fighting . . . and so on.

Our back yard is the stratosphere. The Republic Thunderbolt is built to fight at 35,000 feet and up. It protects high-flying bombers.

Powered with a 2,000 horsepower engine, the Thunderbolt flies at more than 400 miles an hour. Its turbo-supercharger assures greatest efficiency in the rarified upper air.

The stratosphere is the strategic area . . . the ceiling [illegible] of today's global air war. Because of the higher speeds it permits . . . and its freedom from turbulent weather . . . the stratosphere will be the favored path of tomorrow's high-speed transportation. Thus, the high-flying Thunderbolt anticipates happier things to come.

Republic Aviation Corporation
Farmingdale, New York—Evansville, Indiana

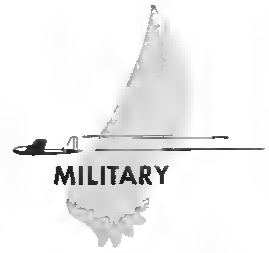
REPUBLIC Aviation

FARMINGDALE DIVISION

SPECIALISTS IN HIGH-SPEED AIRCRAFT

Raid Training in The Mediums

At special transition fields, new pilots are learning to master the "Mighty M's"—*Marauders* and *Mitchells*, the masters of the Axis.



BUILDING THE AAF
PART III

WHEREVER FLYING MEN GATHER, the talk inevitably gets around to two streamlined, lethal airplanes that are helping pile up yardage for the Air Forces' team.

The B-26 Martin *Marauder* and the B-25 North American *Mitchell* inspire respectful discussion, for they are the kind of devastators around which legends and tradition are built. The Air Forces' "Mighty M's," they look tough and are.

So that more men may fly these hard-punching craft, hundreds of students today are assigned to transitional training at fields of the AAF Training Command. Typical of the new B-25 post-graduate schools is that at the La Junta, Col., Air Base, where students of the two nations which have prime cause to hate the Japs are training. Pilots of the United States and China inaugurated this new transition school last Spring—two days after the first anniversary of Gen. Doolittle's B-25 raid on Tokyo.

Although they learned the rudiments of twin-engine operation in advanced school, student officers still get a thrill when they are introduced to the twin-tailed *Mitchell*. Navigation is emphasized because, like Doolittle's men, they will probably be called on to fly through uncharted heavens at night and in storms. If the regular navigator is incapacitated, the pilot is trained to take over his responsibilities. Thorough courses in aircraft and naval vessel identification ready the pilot for the day he will bring his plane into position for the gunners and bombardiers to do their work. To get an "eye" for



After 33 hr. ground familiarization with *Marauder* parts and instruments, plus more hours of takeoffs, landings, and navigation, students take ship on cross country flights. "Boot Hill" (seen in name of this plane) is cowboy lingo for "cemetery."

Amazing Performance at Extremely High Altitudes





LOCKHEED P-38 LIGHTNING is equipped with WITTEK AVIATION HOSE CLAMPS

Flying faster, higher and farther than any enemy fighter . . taking punishment, yet still delivering the goods—the Lockheed P-38 Lightning is equipped with Wittek Aviation Hose Clamps. Today, as in the past, Wittek Aviation Hose Clamps, known as the standard of the industry, are being used by the nation's leading military aircraft and engine builders. Wittek Manufacturing Co., 4305-15 West 24th Place, Chicago 23, Ill.

ARMY E NAVY

WITTEK Aviation HOSE CLAMPS

. . . BUY MORE WAR BONDS

Understanding of flight instruments is simplified with this B-25 "phantom panel" which can be tilted or rotated to show instrument reading changes at various plane attitudes. Capt. George E. Wagoner, assistant director of academic training, Mather Field, Calif., points out a feature of device to Maj. Bruce H. Hinton, unit commander.

ripping open enemy planes with the B-25's fixed machine guns, the students at La Junta shoot skeet, practice with pneumatic pellet throwers, and fire .30 cal. guns on the range. Finally, there is instruction in firing guns mounted in rear cockpits of specially-rigged North American AT-6's.

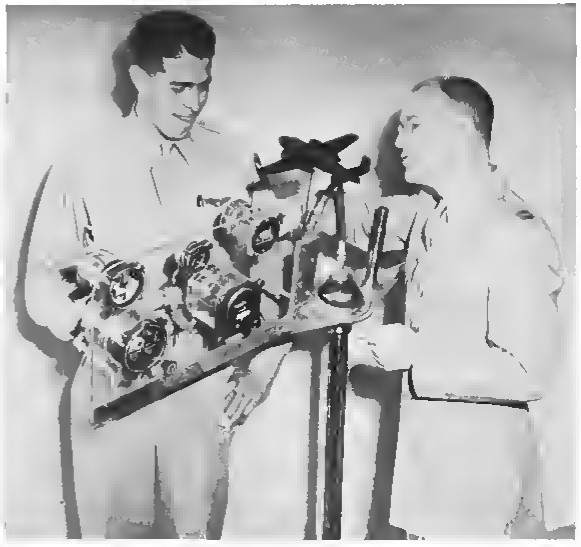
Every member of the Chinese contingent at La Junta has a long list of scores to settle with the Japanese, a majority of them are out to avenge the deaths of relatives or friends.

"We promise Gen. Doolittle," says their commanding officer, Maj. Lung Ming-teh, that "we'll be coming in behind him on the trail to Tokyo." Maj. Lung twice has been decorated by Generalissimo Chiang Kai-shek personally, once for dive-bombing the Japs more than 20 times, again for shooting down five enemy planes.

At Laughlin Field, in Texas' Rio Grande Valley near the border town of Del Rio, other AAF men are getting acquainted with the *Marauder* in one of the Training Command's B-26 transition centers. This swift medium bomber calls for a carefully graduated nine-weeks of transition. The first 33 hrs. of training, spent on the ground, familiarizes the students with the plane's various parts, also with its instrument panel's multitude of devices.

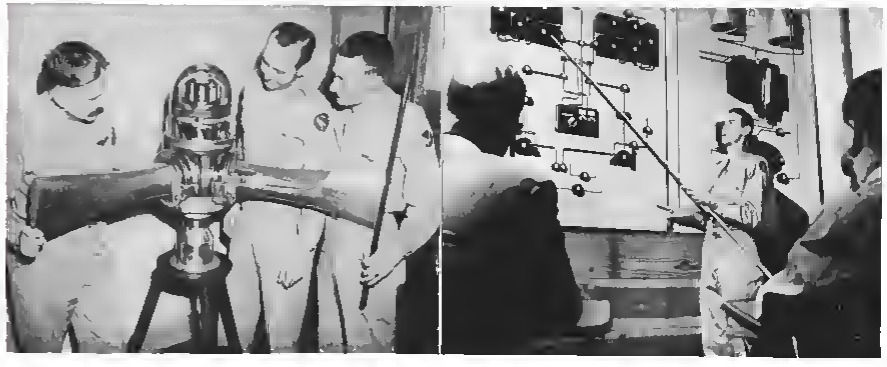
Approximately half of the future *Marauder* men's daily work is taken up

(*Turn to page* 305)





Anxious to follow Doolittle to Tokyo, both Americans and Chinese put in long avigational hours in *Mitchell*



In ground school, future pilots (left) investigate intricacies of Hamilton Standard hydraulic constant-speed propeller and (right) trace key units of B-25 fuel and oil systems with aid of wall mock-ups.

Flying High



FLYING HIGH today depends on good head work on the ground. Broaching has played a large part in the feats of aeronautics in the air and on the ground. It has made possible an interchangeability of parts unequaled in the industrial history of this or any other country. It has made possible practically unlimited supply of parts available within a short while of change of design. Take for example, the propeller hub:—The new type variable pitch propeller was still in blueprint stages when broaching was called into the picture.

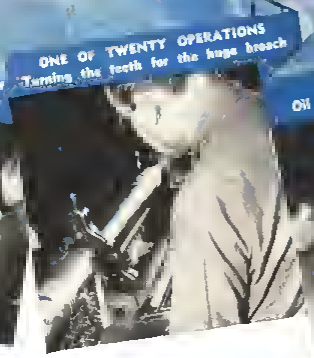
"Could a more than goodly number of these hard steel hubs be turned out with exact precision within a given time?"

Before the first hand machined hub had finished its test, a set of broaches had been designed and made which would spline the inside of the hub to an exacting tolerance in few minutes precision operation. The first plane props using this hub were raising the dust in Africa months ahead of schedule. Due to broaching's ability for high speed precision production the ten thousandth hub more than met the "specs"

More and more of the fifty thousand vital parts that go to make up the flying wonders of today are being broached. By broaching as by no other method of machining can you get Primary Production Precision — it's broaching today.


GOOD HEAD WORK ON THE GROUND
Engineering and Production Departments plan manufacture

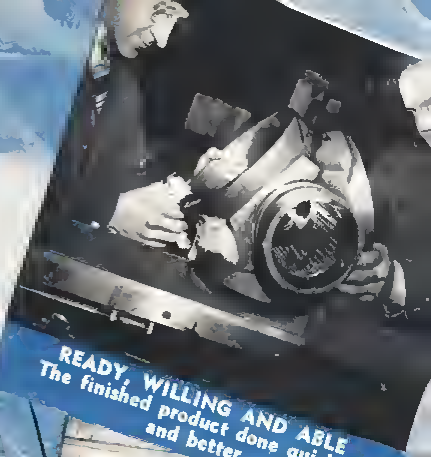

FROM BAR STOCK TO BROACH
Preliminary turning of the rough bar stock

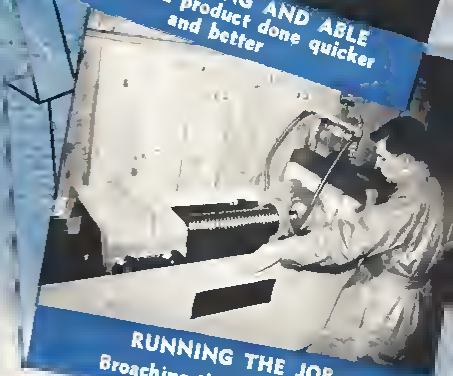

ONE OF TWENTY OPERATIONS
Turning the teeth for the huge broach


HEAT TREATING
Oil quenching the [illegible]


HARD STEEL
Preliminary hardness testing after heat treating


TWELVE FINISHING OPERATIONS
Grinding the splines in propeller


READY, WILLING AND ABLE
The finished product done quicker and better


RUNNING THE JOB
Broaching the propeller hub

ARMY E NAVY

The LAPOINTE Machine Tool Company

HUDSON • MASSACHUSETTS • U.S.A.



Ever see a hydraulic cylinder you could take apart with a screwdriver?

Here's one! It's a Maytag

Out where the going is tough, the ground crews, backing up our flyers, have a whale of a job on their hands That's why it's important to give our forces equipment that's just as foolproof as possible And that's where Maytag comes in.

For Maytag Hydraulic Cylinders are virtually foolproof. They embody exclusive principles and simplified design that make them easier for you plane manufacturers to install... make them more dependable in operation and so easy to service they may be taken apart and put together again without need for special tools

In the aircraft industry, the word is getting around that you can depend on Maytag Hydraulics.

THE MAYTAG COMPANY, NEWTON IOWA

Maytag



Maytag also produces Eclipse electric retracting units ... aluminum alloy aircraft castings.



KEEP POSTED ON

Products & Practices

This selected information on new publications and products is offered by the "AVIATION" Reader's Service through cooperation with the manufacturers. It helps executives save valuable time, provides profit through convenience. To obtain literature or additional data on new products described, simply fill in form below,* clip it to your letterhead, and mail. There is no cost, no obligation.

PRODUCTION

Machine Operation 1

Subjects covered in series of brief, descriptive articles in pamphlet from E. F. Houghton & Co., Philadelphia, include rust prevention, final casting of high speed steel tools, cutting fluids for magnesium alloys, and circulating quenching oil

Metallizing 2

History, development, applications, and technique of all forms of metallizing for restoring worn machine parts are described in 40-page catalog prepared by Metallizing Co. of America, Chicago Specifications and engineering data are also given on company's metallizing gun.

Tube Bending 3

American Tube Bending Co., New Haven, Conn., publishes booklet picturing various forms made with aluminum and steel intakes, assemblies, oil lines, mountfolds, and checking fixtures Custom work is offered plane and engine manufacturers

Abrasive Cutting 4

Tips on how manufacturers have improved process of abrasive cutting are contained in illustrated folder with chart of six types of machines made by Amtrew C Campbell Div. American Chain & Cable Co., Bridgeport, Conn.

Sawing 5

Job Selector Chart showing pitch and saw velocity for cutting various thicknesses of steels, copper, brass, aluminums, etc., is contained in illustrated booklet on applications of Doall saws. The Doall Co., Des Plaines, Ill

Designing, Tool Service 6

Leaflet illustrates and describes service in production engineering and tooling available to manufacturers through Atlas Metal Stamping and Tool Designing Co., Philadelphia

Lathe Estimating 7

Herm Estimating Table for Lathe Work, available at $1 from Raymond Herm, Jamaica, N. Y., gives formulas for calculating work time and contains charts on standard turns in minutes for cuts 1 in long with feed of .001 on materials of various diameters

Tool Sharpening 8

Advantages and illustrations of process of hand stoning are shown in booklet *Hand Stoned Cutting Tools for Faster, Better, More Cuts*, prepared by Behr Manning, Troy, N. Y.

Broaching Article 9

Article on broaching aircraft parts is included in booklet, *A Quarter Century of Broaching Development*, offered by Colonial Broach Co., Detroit Also shown are various types of machine equipment made by firm

Cone Gearing 10

Michigan Tool Co., Detroit, has prepared instruction manual CA 43 on assembling and checking "Cone-Drive" area contact gearing in housings for low and high production Included is a discussion of production control methods

Die Sections 11

Jessop Steel Co., Washington, Pa., has prepared folder showing sectional views and available sizes of its rolled composite sections for die making Cutting edge is electric furnace melted, water hardened tool steel backed up by a non-hardening steel.

MACHINERY & ACCESSORIES

Punch Presses 12

Bulletin No. 24 from Wiedemann Machine Co., Philadelphia, announces hand operated punch presses said to eliminate drilling and fly and hand cutting They have eleven or twelve dies and punches available up to 1½ in. dia. for piercing materials ranging from slum stock to ¼ in. mild steel

Power Transmission 13

Booklet produced by Cling Surface Co., Buffalo N. Y., on planned power transmission contains illustrated suggestions on advantages and costs of group machine drives, maintenance of shafting, belting pulleys, and a salvage program for belting and drive components

Hole Saws 14

Available for cutting holes from ¾ to 4½ in. dia. in steel, brass, aluminum, and wood up to 1½ in. thick, hole saws produced by Armstrong Blum Mfg. Co., Chicago, are illustrated in Bulletin HS 42 which lists prices and specifications

Bearing Lubrication 15

"Multival" system for simultaneously lubricating number of machine bearings from a central point is diagrammed and pictured in Bulletin No. 15 from Farval Corp., Cleveland Operator forces oil or grease into central distribution block from which it is carried to as many as ten bearings through tubes

Drill Presses 16

Engineering information, descriptions, and illustrations of 75 models of drill presses manufactured by Bolce Crane Co.,

* AVIATION READER'S SERVICE

OCTOBER

AVIATION, 330 W. 42nd St., New York City

Please send me additional information according to key numbers circled

INFOSMATION TIPS.						1	2	3	4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21	22	22	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39									
NEW PRODUCTS:					40	41	42	43	44	46	46	47	48	49	50	51	52
53	54	66	56	57	66	59	60	61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80	81	82	83	84	86	86		

NAME TITLE

FIRM OR AFFILIATION

ADDRESS



Toledo, are shown in folder from company

Presses, Pumps 17

Pressures from 10 to 200 tons on small areas for die sinking, straightening, or compression tests are available from line of hydraulic laboratory presses. With electric or steam heated platens they can also be used for manual hot molding. Bulletin 350 A from Watson Stillman, Roselle, N. J., illustrates various models of these presses, and Bulletin 250-A shows the company's line of hydraulic pressure pumps available from three to 200 hp.

Spot Welder 16

Operating, mechanical, and electrical features and performance graphs of press spot welder for aluminum and its alloys are pictured in booklet from Sciaky Bros., Chicago, Ill.

PLASTICS

Plastacele 19

Loomleaf *Plastacele Handbook*, prepared with numerous illustrations by Plastics Dept., E. I. du Pont de Nemours, Arlington, N. J., gives descriptions and engineering statistics on Plastacele cellulose acetate sheets. Topics covered are applications, forms, shapes, and sizes, care and handling, fabricating, sawing, shearing and breaking, blanking and punching.

Non-Metallic Materials 20

Seven non-metallic materials and plastic substances for various engineering and product purposes are illustrated in bulletin published by Continental Diamond Fibre Co., Newark, Del. It also contains charts showing suitable applications of these substances and their specific properties.

Tooling 31

Bulletins and engineering data have been compiled by Machine & Tool Designing Co., Philadelphia, showing further applications of the "Formarite" method of toolmaking with chemical materials which solidify in molds without shrinkage at room temperatures.

Molding 32

Imperial Molded Products Corp., Chicago, has issued folder with comparative table of characteristics of various compression molded plastics. Also illustrated are company's custom molding facilities.

Tubing 23

Elmer E. Mills Corp., Chicago, presents, in 40 page booklet, list of physical properties of its plastic tubing, chart of properties of various injection molded plastics, and illustrated descriptions of molding processes and various types of plastic compositions.

ELECTRICAL

Magnetometers 24

Illustrations, general descriptions, operating directions, and calibrations of two types of magnetometers are given in Bulletins No. 90 and No. 91 prepared by Waugh Laboratories, New York City. Models are designed for magnetic control of airframes and for determining magnetic fields in materials, members, and parts.

Switches 25

Ten types of small electric switches suitable for aircraft applications are shown in folder prepared by Acro Electric Co., Cleveland. Contained are specifications, blueprints, and capacities.

Connectors 26

Twelve types of DP electrical rack and panel connectors are shown in catalog from Cannon Electric Development Co., Los Angeles. Listed are general uses; construction features; face, sectional, and rear view drawings, and tables of contacts, capacities, and assembled weight.

Catalog 27

Thomas & Betts Co., Elizabeth, N. J., has revised and expanded *Aircraft Catalog* No. 90 on its electrical connectors for aircraft wiring to include three sections on terminals and one each on bonding jumpers and specialties.

Maintenance 36

Handbook offered by Ideal Commutator Dresser Co., Sycamore, Ill., contains 88 pages of information on company's equipment and suggestions on keeping motors and generators in constant efficient operation without dismantling.

Fitting Chart 29

Pocket size card prepared by Union Aircraft Products Corp., New York City, shows range of fittings, dimensions, and part numbers of standard AN conduit connections.

MANAGEMENT & EMPLOYEES

Tax Deduction Device 30

George S. May Co., Chicago, is distributing free its "Deduct-O Graph," a stiff paper, book sized calculator. When set according to an employee's marital status, wage range, and pay period it automatically shows the amount of his tax deduction.

Waste Reduction 31

Enlisting Employees in Waste Reduction, latest publication of Policyholders Service Bureau, Metropolitan Life Insurance Co., New York City, reports methods used by several companies to gain employee support and contains check lists of points of mutual employee-management interest and cooperation.

Report Guide 33

Among literature available from Alexander Hamilton Institute, New York, is 72 page guide book, *How to Prepare an Engineering Report*, especially written for technical men.

Incentive Suggestions 33

Navy Dept. announces publication of booklet, *Ideas That Work to Win*, containing tips to management on creating war spirit, reducing absenteeism and rejections, and qualifying for the "E" award.

Skin Protection 34

Seven suggestions to workers on skin protection have been printed on card suitable for posting on washroom walls by Quaker Chemical Products Corp., Conshohocken, Pa.

IDEAS & SERVICES

Materials Conservation 35

Latest materials conservation broadside issued through Army, Navy and WPB Aircraft Production Board gives examples of how various companies have effected savings through new manufacturing processes.

Plane Tires 36

Airplane Tire Section, made for insertion in its aeronautical manual by B. F. Goodrich, Akron, contains charts of sizes, types, dimensions, weights, low and high pressure capacities, loads, and inflation of non-skid and smooth auxiliary and landing wheel tires.

Air Transport 37

Sources of information and literature published by airlines on various phases of operation are listed in folder compiled by United Air Lines School and College Service, Palmer House, Chicago.

Bibliography 38

Bibliography prepared by U. S. Forest Products Laboratory, Madison, Wis., lists magazine articles on preparation of woods and uses of woods in various forms, including a special section on molding, glueing and effects of temperature changes on plywoods.

Hose, Sheet Material 39

Manufacture, applications, dimensions, and specifications of chemical resistant hose, tubing, and sheet material for gaskets, washers, etc., made from "Resistoflex PVA" a synthetic resin, are compiled in aircraft catalogue by Resistoflex Corp., Belleville, N. J.

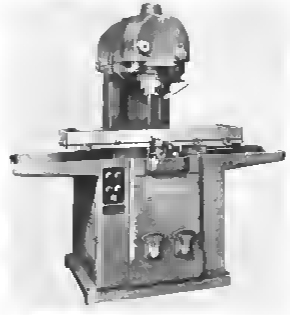
O Announcements of new machine tools, shop equipment, and accessories are invited for inclusion in these columns. In writing, emphasis upon aviation industry applications of newly-marketed items is desirable, and wherever possible, glossy-print photos should be enclosed for illustration. Manufacturers should address New Products Editor, AVIATION, 330 W. 42nd St., New York City.

Latest Machine Tools



Vertical Miller 40

Model 2-20V vertical milling machine introduced by **Kent Owens Machine Co.**, Toledo, has 42x12 in. table traveling 20 in. on bed with automatic cycle. Table can be fed automatically, traversed in either direction, automatically stopped during travel, and reversed at either end of its stroke. Three column heights permit gaps of 10, 12, or 14 in. with 4-in. vertical quill adjustments. Driving mech-



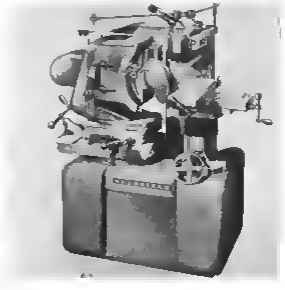
anism, involving three sets of gears, has anti-friction bearings and automatic lubrication. Standard spindle speed range is 64 to 860 rpm. with ranges of 42 to 428 and 96 to 1,248 available. Table travel can be adjusted separately for both directions so that feed rate can be faster in one direction than the other.—AVIATION, *Oct.*, 43

Tube Extruder 41

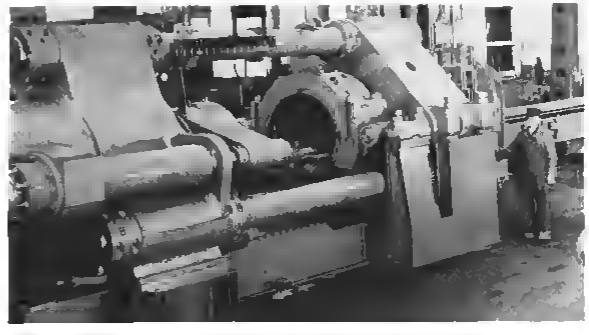
Special design of supporting platen and container holder in centerline of container is reported by **Schloemann Engineering Corp.**, Pittsburgh, to reduce frequency with which its tube extrusion presses have to be readjusted to produce uniform wall thickness. Keys in container fit in ways in housing permitting container housing to expand evenly. Platen and container holder expand and contract in constant alignment with centerline of cold press stem section.—AVIATION, *Oct.*, 43

Finish Grinder 42

Designed to eliminate need for templates in the finish grinding of profiles



on circular and flat form tools, gages, cams, dies, etc., new machine made by





First Phenol

to offer all these wood-gluing advantages

DURABLE. Proof against boiling or cold water, dry heat, cold, mold and bacteria, organic solvents.

NON-ACID. Does not weaken wood fibres adjacent to the glue line.

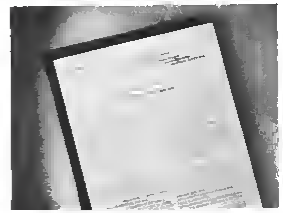
WIDE RANGE OF SETTING TEMPERATURES. 70° F. and up for softwoods, 110° F. and up for hardwoods.

NON-CRAZING, LOW SHRINKAGE due to its low water content and particular molecular construction.

LONG PERMISSIBLE ASSEMBLY PERIOD.

LOW PRESSURES ADEQUATE.

ADAPTABLE—to joint gluing, laminating, hot-pressing, bag-gluing.



JUST POINTED—new Technical Bulletin 104a—Eight pages, complete details on mixing, spreading, pressing, testing of Cascophen LT-67. Keep up to date. Send for your copy. Address: Casein Company of America, Dept. A-10, 350 Madison Avenue, New York 17, N. Y.

CASCO (casein)

CASCAMITE (urea resin)

CASCOPHEN (phenol resin)

Aircraft Glues

to meet all aircraft specifications



We Can't Give You Anything but HATE

Reliable

We hate war, but we hate dictators more Right now, helping to exterminate phoney supermen who fight to dominate the world is our main job Reliable Springs by the millions have gone into vital combat and war production equipment of all types. Reliable workers, both men and women, have given valiantly and unstintingly of their strength to help turn out more and better springs—faster and faster. The urgency of this huge task has literally kept our people's noses to the grinders, their hands, eyes, minds, attuned to the coilers, formers, testers, and all the other equipment of fine spring-making. The result is springs of extreme precision and almost incredible accuracy in action, under the excessive stresses of war

The school of war is a tough school When Peace again prevails, Reliable will be even better prepared than before, to serve your customary requirements



Send us your drawings and specifications

THE RELIABLE SPRING & WIRE FORMS CO.

3167 Fulton Rd., Cleveland, O. *Representatives in Principal Cities*

YOU CAN RELY ON

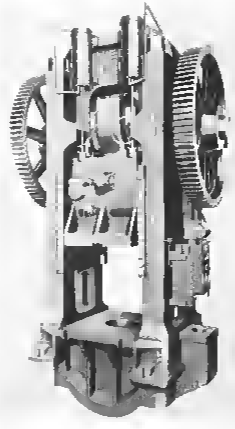
Reliable Springs

ROUND AND FLAT WIRE SPRINGS · CLIPS · HOOKS · BENDS · LIGHT STAMPINGS

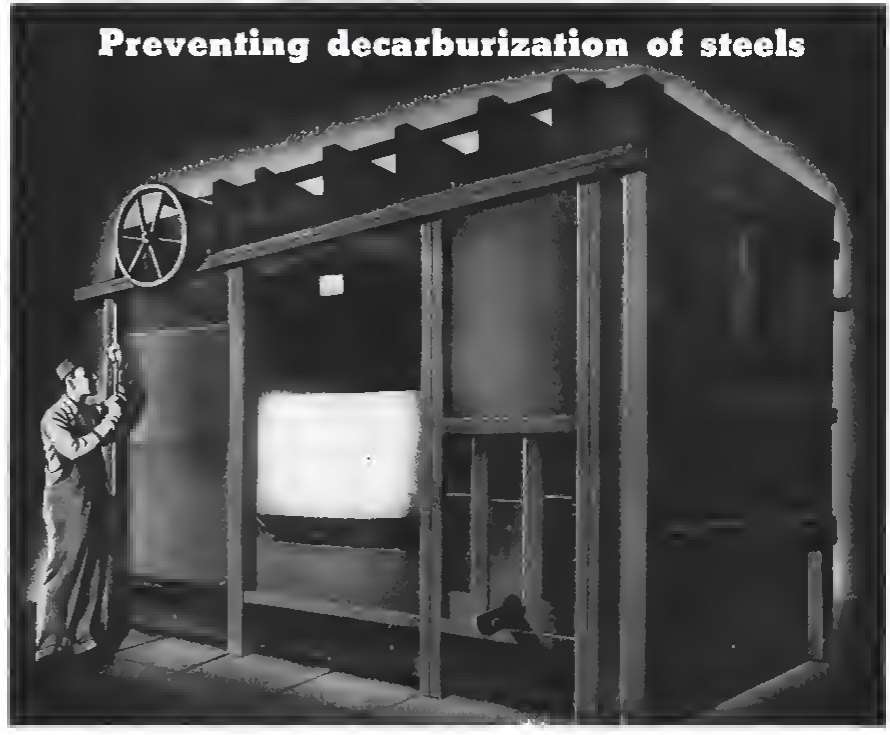
Sheffield Corp., Dayton employs 50-to-1 pantograph and microscope As operator follows 50 to 1 scale drawing with pantograph, microscope with cross hatred lens follows according to shape to be ground Operator feeds grinding wheel, adjustable to any desired angle, so that its cutting edge works toward point marked by crosshairs, this position corresponds to that of pantograph stylus Accuracy is said to be unaffected by grinding wheel wear and obtainable to 0003 in Layout size 20 in sq per nuts single setting grinding area 0 400x 0 400 in Work accommodation is 10 in wide by 4 in thick, and stock can be stacked up to 2 in high for making identical parts Used in reverse, machine will make 50-to-1 layout drawings from parts with unknown profiles — AVIATION, *Oct*, '43.

Trimming Press 43

Said to be one of largest ever built, this 2,000-ton mechanical trimming press, reports **E W. Bliss Co.**, Brooklyn, is capable of handling average run of forgings from 33,000-lb-capacity hammer Triple gearing and twin drive crankshaft permit five strokes per minute Frame is four-piece, tie-rod construction Air friction clutch is multiple disk flywheel type, and brake has electric push-button control Specifications: Air counterbalanced slide stroke 24 in; slint height adjustment distance (top of



Preventing decarburization of steels



Information supplied by an Industrial Publication

The principal factors that must be considered in any attempt to prevent the decarburization of steel are the steel analysis, temperature and time of heat treatment and the furnace atmosphere.

All of them are subject to modification, or control, as a means of prevention. But since changes in steel analysis, or in temperature and time of treatment are often impractical, the furnace atmosphere offers the best general point of attack.

If the furnaces in use are basically unsuitable, the best method of correcting the trouble is to replace them with controlled atmosphere furnaces carefully selected to meet individual requirements. If this cannot be done, an analysis of the furnace atmospheres should be made to determine whether or not carbon dioxide or water vapor are present. If they are, one remedy consists of installing auxiliary equipment to eliminate the CO_2, and to reduce the H_2O to the lowest possible level.

There is another method that may work if light scale on treated parts is not objectionable. This consists in using a slightly oxidizing atmosphere (2-5%). Decarburization of certain high carbon and tool steels is virtually eliminated. The method is safe to try with steels that do not require temperatures over 1600° F.

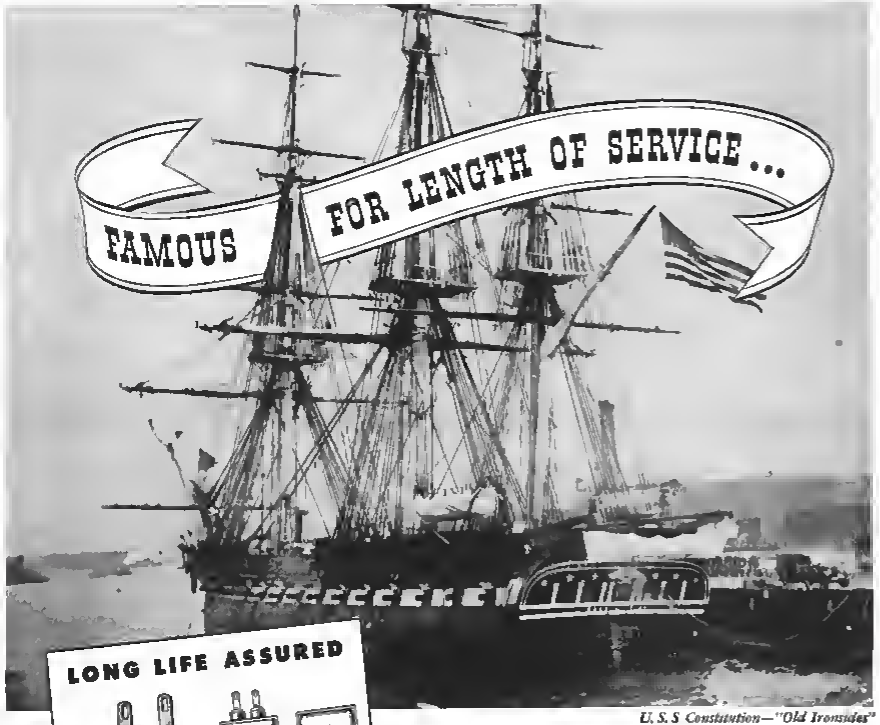
CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

ARMY E NAVY

MOLYBDIC OXIDE, BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"

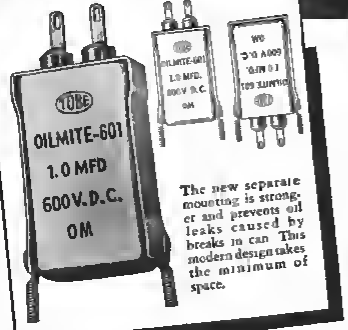
Climax Molybdenum Company

500 Fifth Avenue · New York City



U. S. S Constitution—"Old Ironsides"

LONG LIFE ASSURED



The new separate mounting is stronger and prevents oil leaks caused by breaks in can. This modern design takes the minimum of space.

YOU WANT capacitors that can stand up and take it. The well-nigh flawless record of Tobe Capacitors as to "returns" proves they have that outstanding requirement of durability.

This quality is built into each and every Tobe Capacitor by advanced engineering practices and production methods. And their rating is always an "understatement".

Shown here is the Tobe Oilmite Capacitor. Filled and impregnated with mineral oil it is used as a filter condenser in war equipment. The new hold-down bracket permits inverted or upright terminals, with wiring either underneath or on top of chassis.

TYPE	OM
RATINGS	.05 to 2.0 mfd. 600 V.D.C. .05 mfd. to 1.0 mfd. 1,000 V.D.C.
STANDARD CAPACITY TOLERANCE.	±10%
TEST VOLTAGE	Twice D.C. rating
GROUND TEST	2,500 Volts, D.C.
SHUNT RESISTANCE	.05 to 0.1 mfd. 20,000 megohms .25 to 0.5 mfd. 12,000 megohms. 1.0 to 2.0 mfd. 12,000 megohms
POWER FACTOR	At 1,000 cycles—.002 to .005
CONTAINER SIZE	Width 5/8", length 1-5/16", height 2¼"
MOUNTING HOLE CENTERS	1½

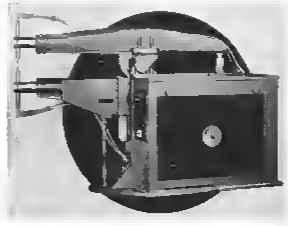
TOBE DEUTSCHMANN CORP.
TOBE
CANTON · MASSACHUSETTS

A SMALL PART IN VICTORY TODAY—A BIG PART IN INDUSTRY TOMORROW

bed to slide with stroke down) 42 in.; slide area F to BXR to L 87x60 in., bed area F to BXR to L 98x72 in., weight 450,000 lb—AVIATION, *Oct.*, '43.

Aluminum Welder 44

Progressive Welder Co., Detroit, has designed rocker arm machine for condenser-discharge welding of any combination of two thicknesses of 24ST



Alclad sheet from 0.016 to 0.081 in. at rates between 1,000 and 2,000 spots per hour including point dressing time. Rigid machine design is stated to reduce frequency of point dressings. Throat depth is adjustable from 36 to 42 in., and upper arm retracts for insertion of flanged work. Lower arm can be adjusted 10 in. vertically. Refrigerated electrodes can be installed at extra cost. Pancake transformers, rated at maximum of 3,000 v.a., can be tapped for different turn ratios by special switch. Standard equipment includes solenoid valves for controlling air mechanism, air pressure gages, regulating valves, air line lubricator, and dual shrouded operating treadle.—AVIATION, *Oct.*, '43.

Punching Unit 45

Type AA hole punching unit introduced by **Wales-Strippit Corp.**, North Tonawanda, N. Y., has either single or triple spring stripping guide assembly for metals .076 and ¼ in. thick. On stamping presses unit is mounted on a template, on press brakes on adapters clamped to rail.—AVIATION, Oct., '43.

Spot Welder..... 46

Automatic control of pressure, weld, hold, and off time and speed up to 210 strokes per min. is reported feature of press type spot welder P-20 of **Pier Equipment Mfg. Co.**, Benton Harbor, Mich. Variations are provided in cycle. Air cylinder, which can be regulated by valve, supplies pressure for upper electrode. Eight-point selector switch adjusts current from half to full maximum. Two capacities, 20 and 30 KVA, are made with 12 or 24 in. throats.—AVIATION, *Oct.*, '43.

HIGHEST DEVELOPMENT IN CONNECTORS FOR RACK AND PANEL EQUIPMENT . . .



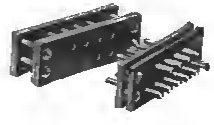
Cannon DPR

THE CANNON "DP"

The 40 contacts in the DPR, shown above, present a "force problem" in disconnecting which is solved by the geared bail. It is especially desirable in cramped or inaccessible quarters. The DP series of connectors has been developed exclusively by Cannon, in conjunction with airline engineering personnel, for communications work in planes and tanks. Cannon DP's are the highest development in electrical connectors of the self-aligning type for use where space is limited and connections must be made speedily and with absolute certainty.



Cannon DP-D. Available with insert arrangements of 12 to 32 contacts—10, 15, 40 amp. and from one to four coaxials. A "quick change" connector.



Cannon DP-P. Generally classified as a panel type although equally adaptable to radio rack assembly. Has no stand and shell—insert assembly only.



New 24-Page Bulletin on CANNON DP CONNECTORS gives general information and description of parts, applications as well as dimensional sketches and tabular matter. Write Dept. A-110, Cannon Electric Development Company, Los Angeles, California.

CANNON ELECTRIC

Cannon Electric Development Co., Los Angeles, Calif.

Canadian Factory and Engineering Office: Cannon Electric Co., Ltd., Toronto

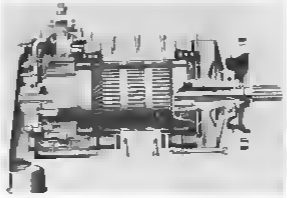
REPRESENTATIVES IN PRINCIPAL CITIES—CONSULT YOUR LOCAL TELEPHONE BOOK

Shop Equipment & Accessories

Generator, Regulator..... 47

Eclipse-Pioneer Div., **Bendix Aviation Corp.**, Teterboro, N. J., has developed two new aircraft electrical products, one a high speed generator, other a carbon pile voltage regulator. Designed after AAF specification P-2, generator (illustrated) can be used on auxiliary or main engines. It will deliver rated load of 200 amp at 30 v. or 6 kw. over speed range of less than 5,600 to 10,000 rpm. Three-quarters rated output is available at 4,400 rpm. Cooling air from integral fan circulates through hollow armature shaft. Interpole and compensating coils, which develop auxiliary magnetic fields, help prevent sparking at brushes. Generator weights 36 lb. Frame measures 12⅝ in. with 6 in. dia. Type 1042 voltage regulator consists of stack of carbon disks upon which pressure is raised or lowered by leaf springs controlled by an electro-magnet. This action varies resistance of stack which is connected in generator field circuit. Magnet is actuated by voltage generated. Regulator is designed for 24-v. aircraft systems with





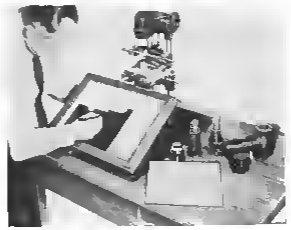
generators in single or parallel and rated from 1.5 to 6 kw. It can also be used with 30 v. generator requiring resistance range of 7 to 55 ohms if maximum wattage does not exceed 75 continuously. Operation at 100 w. is possible where regulator can be blast-cooled. Said to vary no more than 2 v., regulator weighs 2.6 lb., measures 4⅞x4⅛x3¾ in.—AVIATION, *Oct.*, '43.

"Alloy" Plastic..... 48

Plastic which can be given various characteristics—hardness, softness, elasticity, toughness, freedom from magnetic attraction—has been introduced by **Emeloid Co.**, Arlington, N. J. It is reported suitable for usual machining and finishing operations.—AVIATION, *Oct.*, '43.

Tracing Projector..... 49

Now on market is new model projector equipped with 2 in. dia. condenser, ½ in. larger than type previously offered by maker, **George Scherr Co.**, New York City. Bigger condenser permits use of larger low-power lenses; 10X magnification is 1⅝ in. dia., 20X ⅞ in. dia. Other



available magnifications are 31¼X, 50X, 62½X, and 100X. Streamlining and improved ventilation have been designed into enclosed head and lamp house, and spiral gears are used in focusing.—AVIATION, Oct., '43.

Rivet Gun..... 50

Goodyear Aircraft Corp., Akron, announces light, quick heating gun for explosive rivets. Low voltage and high



amperage power is conducted to high resistance metal tip when operator squeezes trigger, heating tip and detonating rivet.—AVIATION, *Oct.*, '43.

Elevating Table..... 51

Hydraulic table for elevating work to desired height with maximum load of 2,000 lb. now incorporates following features: Floor lock to prevent movement on casters; spring-balanced towing handle, device permitting top to be rotated and locked each 15 deg. throughout circle; collapsible bars to contain work on table top, and two-speed hydraulic foot pump. Standard size made by **Lyon-Raymond Corp.**, Greene, N. Y., has top 30 in. square and elevating range of 29 to 43 in.—AVIATION, Oct., '43.

Rotable Transformer..... 52

Developed by **Kollsman Instrument Div.**, Square D Co., Elmhurst, N. Y., rotable transformer for electronic devices weighs 10 oz. and has an over-all length of less than 3 in. Operating on



Prompt Delivery!

ON THESE WESTINGHOUSE WELDERS

Need a-c or d-c arc welding machines? Westinghouse offers any of the models shown on this page for *immediate delivery*.

Westinghouse A-C Arc Welders boost welding speeds from 15 to 30 per cent . . . because arc blow is eliminated; heavier electrodes can be used; no "time-outs" for maintenance arc necessary.

Westinghouse D-C Flexarc Welders, with new Arcontrol, are the favorite of welding engineers and operators everywhere. Just one simple adjustment gives the welding current desired . . . and Arcontrol offers choice of three types of arc.

For quick delivery or more information, call your Westinghouse distributor or Westinghouse office.

J-90477



FOR HEAVY-DUTY, PRODUCTION WELDING

A-C Welder Model WC-3C—500 amperes. Infinite number of current settings from 100 to 625 amperes.



FOR HEAVIER THAN AVERAGE WORK

A-C Welder Model WC-2C—300 amperes. Infinite number of current settings from 60 to 375 amperes.



FOR ALL-PURPOSE WELDING

A-C Welder Model WT-4C—200 amperes. Has 27 different current settings from 20 to 250 amperes.



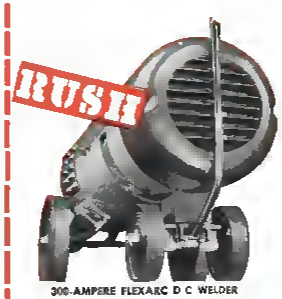
FOR MAINTENANCE AND LIGHT WORK

A-C Welder Model WT-2C—150 amperes. Has 15 current settings from 20 to 140 amperes.



FOR UNIONMELT* WELDING

Westinghouse A-C Welders for use with the Unionmelt Process available in 500, 750, 1,000 and 1,500 ampere models.



300-AMPERE FLEXARC D-C WELDER

New single preset current adjustment plus ARCONTROL. No exciter, rheostat or reactors to fiddle with.

*Registered trade-mark of The Linde Air Products Co

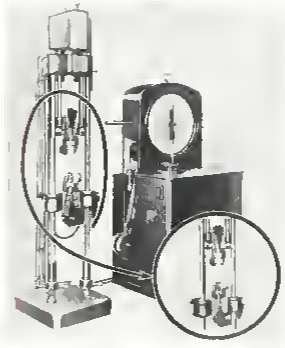
Westinghouse WELDERS

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

either 32 v 60 cycle or 110 v, 400 cycle a-c power supply, transformer can be rotated continuously at speeds up to 1,800 rpm. Voltage varies from 0 to 193 according to position of rotator on an input of 110 v.—AVIATION, *Oct.*, '43.

Parachute Testing 53

Riehle Testing Machine Div., American Machine and Metals, East Moline, Ill., has manufactured hydraulic de-



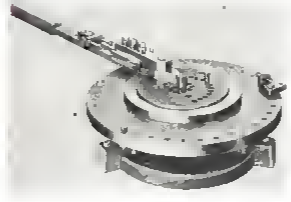
vice for testing parachute webbing up to 10,000 lb. Breaking loads are measured by gravity stress on pendulum and registry can be obtained down to 50 lb. Grips will take samples to 3 in. wide. Maximum testing speed is 12 in. per min.—AVIATION, *Oct.*, '43.

Flaw Divider 54

Two motors each with two synchronized gears are used in device for dividing hydraulic flow from one inlet into two outlets under equal volume regardless of pressure. Intended for controlling various aircraft accessories, unit is available in models for 1,000 and 1,500 psi., recommended maximum pressures, from Pump Engineering Service Corp., Cleveland.—AVIATION, *Oct.*, '43.

Bending Device 55

Tubular, round, square, and flat aircraft materials in aluminum and other metals can be bent to specified shapes on



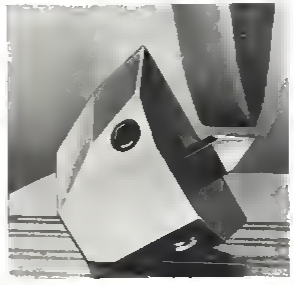
bender which is guaranteed to .001 in. tolerance on duplicating work. Forming nose is reversible, and 35-in. operating leverage can be increased to 80 in. Device's capacity is ½ in. round cold-rolled steel bar, formed cold to 1 in. radius or larger. Net weight, according to O'Neil-Irwin Mfg. Co., Minneapolis, is 215 lb.—AVIATION, *Oct.*, '43.

Rivet Gun Kit 56

Cherry Rivet Co., Los Angeles, is producing a field service kit for work on its blind rivets. Principal items in kit are: G-10 hand gun for use where air pressure is not available, right angle adapter for spots that cannot be reached in a straight pull, pulling heads for countersink and brazier type rivets 4, 5/32, and 3/16 in. dia. Extra recommended equipment is a pair of flat ground nippers for trimming stems of self-plugging rivets. Kit contains instructions and measures 23¼x7¼x2 3/16 in.—AVIATION, *Oct.*, '43.

Grinding Fixture 57

Robart H. Clark Co., Los Angeles, announces thread-tool grinding fixture for



60 and 29 deg. bits. With no scales or moving parts, it is said to be only necessary for machinist to slide bit into holder, tighten setscrew, and place fixture on grinder table at desired angle. Fixture can be used with magnetic chuck or clamped to work table. Two standard sizes are made, one for mechanic's tool kit, other for heavy duty. They will accommodate round or square bits from ⅛ to ⅝ in. for right or left-hand threads.—AVIATION, *Oct.*, '43.

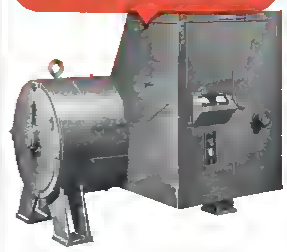
MULTIPLE-OPERATOR SET

ONE

DOES THE WORK OF

20 TO 30

SINGLE-OPERATOR SETS



For continuous-duty, mass production welding where a large number of operators can work in a small area, specify Westinghouse Constant-Potential Multiple-Operator Sets. Welding control panels can be assembled in banks or used singly. Operating power factor, where synchronous motor drives are used, will average 80% leading. Over-all efficiency is 45%.



Operator control panels are available in single and two-operator types. Current range is 150, 200, 250 and 300 amperes. Same range for each operator on two operator types. Dripproof enclosures. For latest literature, write to Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., Dept. 7-N.

J-90477

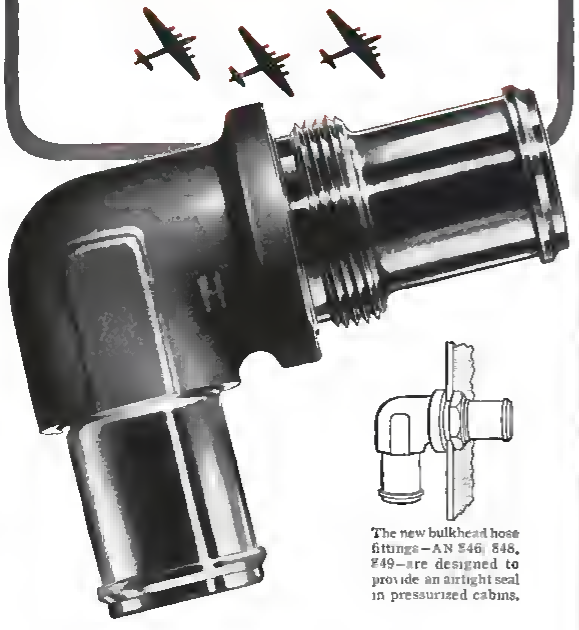
Westinghouse WELDERS

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

NEW **DURAL**

BULKHEAD FITTINGS

FOR PRESSURE CABINS



The new bulkhead hose fittings—AN 846, 848, 849—are designed to provide an airtight seal in pressurized cabins.

EARLY DELIVERY ASSURED

Hartwell's new Dural bulkhead hose fittings—AN 846, 848, 849—are available in thread diameters ranging from ¼" to 1¼". These fittings provide a thread relief space, one and one-half threads wide—between the shoulder and first thread—to permit the lock nut to be tightened against a thin bulkhead partition. An extra thread allows for partitions of varying thickness.

Special tooling inspection after each operation, and final inspection before shipment are enabling us to hold close thread tolerances and i d and o d. dimensions. All fittings except those made from barstock, are pressure tested.

We also manufacture the AN 840-847 series and are tooled to produce fittings from manganese bronze as well as Dural.

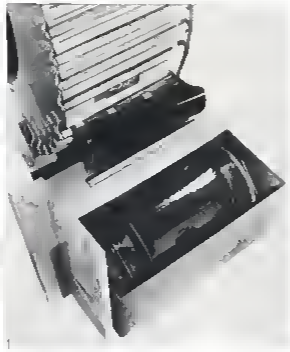
HARTWELL AVIATION SUPPLY COMPANY

Aircraft Production Parts

3417 CRENSHAW BOULEVARD LOS ANGELES, 16 • DALLAS, TEXAS DETROIT, MICH KANSAS CITY, KAN

Film Dryer 58

In use in battle theaters, dryer for aerial photographic film is said to be many times faster and to save critical alloys through construction of zinc-coated metal. Parts include electric



heating unit, variable-speed motor filters, and blower which supplies 2,000 ft of air per min. Developed by AAF Wright Field technicians, and **Lau Blower Co.**, Dayton, dryer handles film to 9½ in. wide and 210 ft. long—AVIATION, *Oct.*, '43.

Transformer 59

Announcement of a new moisture and dust proof transformer that meets all Navy and other specifications for hermetic sealing is made by **Peerless Electrical Products Co.**, Los Angeles. Glass end porcelain insulators with metal bands are soldered into transformer case, which is of cold drawn, copper-plated steel, and thus become an integral part of the case—AVIATION, *Oct.*, '43.

Service Spoon 60

Among cowling and fuselage maintenance tools of **New Britain Machine Co.**, New Britain, Conn., is long turret top spoon. Hammer-forged from alloy spring steel, it can be used in driving, prying, or dinging. Faces are ground



and polished, and end of blade can be used for caulking. Tool weighs 3½ lb.; blade measures 1⅞x5¼x⅞ with 1½-in. handle. Over-all length is 10 in.—AVIATION, *Oct.*, '43.

Cutting Oil Joint 61

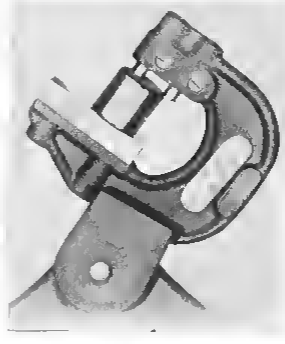
For supplying cutting oils or coolants to the insides of materials being bored or reamed, **Johnson Corp.**, Three Rivers, Mich., is producing a rotary pressure joint which conducts oil to the part through spindle of a turret lathe. The joint, which compensates for misaligned piping, has no packed stuffing box. There are two graphite rings, and pressure within joint itself acts as sealing force—AVIATION, *Oct.*, '43.

"Mushroom" Insert 62

Designed for fastening in plastics, plywood, aluminum, etc., insert made by **Marco Co.**, Wilmington, is fixed in place with hand tool conforming to taper of the insert itself. Pressing down on tool, "mushrooms" bottom of insert fan-wise and locks it in material—AVIATION, *Oct.*, '43.

Snap Gage 63

Limit snap gage No. 1613, offered by **Greenfield Tap and Die Corp.**, Greenfield, Mass., features extended lower



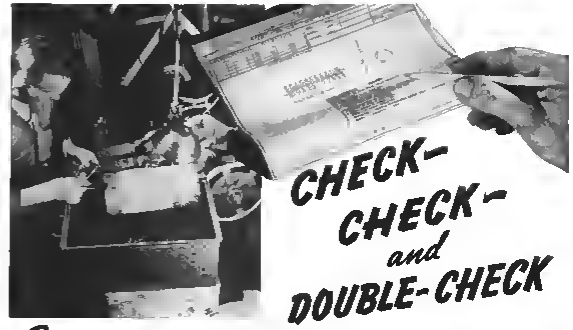
anvil. It is said to facilitate gaging work in machine, as well as inspection, by permitting work to be located and leveled before moving towards "go" and "no go" anvils when measuring diameters and lengths.—AVIATION, *Oct.*, '43.

Turret Lathes 64

Libby Div., **International Machine Tool Corp.**, Indianapolis, announces new line of heavy duty turret lathes in five sizes incorporating different spindle bores for various types of work.

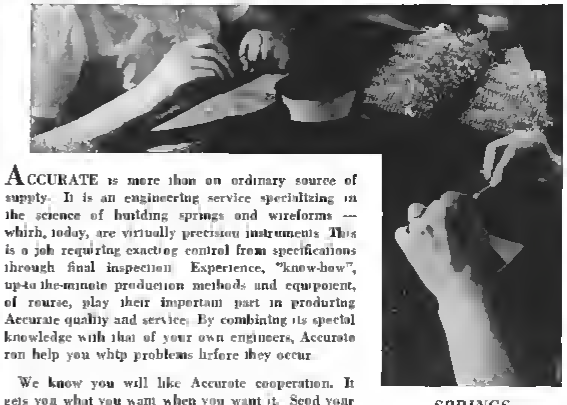
Elliptical chutes in center of the bed direct chips to back of machines for easy removal. With spindle controlled by lever on headstock which operates clutch and spindle brake simultaneously, machine's eight available speeds are controlled by three levers, and 16 speeds are available when models are equipped with two speed (900 and 1,800 rpm.) motors. Standard motor is either 1,500 or 1,800 rpm. of various horsepower depending upon size of lathe. Eight reversible feeds are provided for each of nine lever positions on selective gear box, making a total of 72 changes from

.007 to .500 in. for cutting standard thread, including 7½ and 11½, from 2 to 128. Available models of these machines have capacities of 56 and 72 in., and extra bed lengths can be furnished in 2, 3, 4, 5, and 6 ft. Each face of



CHECK-CHECK-and DOUBLE-CHECK

***Insures* ACCURATE SPRINGS**



ACCURATE is more than an ordinary source of supply. It is an engineering service specializing in the science of building springs and wireforms — which, today, are virtually precision instruments. This is a job requiring exacting control from specifications through final inspection. Experience, "know-how", up-to-the-minute production methods and equipment, of course, play their important part in producing Accurate quality and service. By combining its special knowledge with that of your own engineers, Accurate can help you whip problems before they occur.

We know you will like Accurate cooperation. It gets you what you want when you want it. Send your specifications or ask to see an Accurate engineer.

Send for the new Accurate "Hand Book of Technical Data"

Accurate Springs

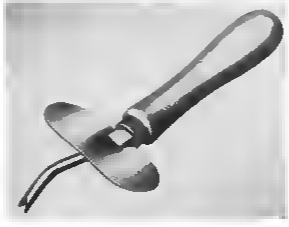
SPRINGS
WIREFORMS
STAMPINGS

NEW PRODUCTS

the turret has an automatic stop for controlling feed to predetermined dimensions. Cross sliding hexagon turret has single cutter boring bars and forged tools and, when set off center, can produce any desired diameter. This turret can bore and face while the square turret finishes the outside diameter thus saving machining time. Bearings, shafts, and gears are lubricated by a combined force and splash system, and positive displacement coolant pump is driven by an extension shaft from the rapid transverse unit. Chucks are available in sizes of 18, 22½, 24, 28, and 32 in. For hydraulic chucks there is furnished a rotating hydraulic cylinder for pressures up to 500 psi.—AVIATION, *Oct.*, '43.

Hook Scraper 65

New hook scraper burring tool with a safety shield to protect fingers and hands from jagged edges of material is announced by **Aircraft Tools**, Los Angeles. Manufactured in two sizes, scraper has oval shield built into shank where it joins handle. It is made of hardened steel and has V notch at end of shank.—AVIATION, *Oct.*, '43

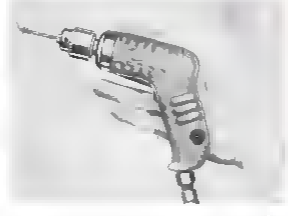


D.C. Generator.....66

Permanent magnet field is feature of small direct current generator for tachometers and event control. Magnets are made of Alnico II. Output voltage is linear with speed within one percent and equal within one percent in either direction of rotation; power delivered is approximately 2 v. per 100 rpm. Maker **Eastern Air Devices**, Brooklyn, lists internal resistance as 230 ohms and required rotation torque as less than ½ oz.-in. Silver instead of copper commutators and brushes are available for low speed installations. Weight is 20 oz., mounting ring diameter 2 5/16 in., and over-all length of aluminum housing 3½ in.—AVIATION, *Oct.*, '43.

Plastic Drill 67

Plastic housing and handle contribute to lightness (1 lb. 12 oz.) of new pneumatic drill operating at 2,500 rpm. With over-all length of 6½ in., it will accommodate bits of ⅛, 5/32, ¼ and 5/16 in. Built-in visible oiler enables operator to check lubrication; slides maker, **Aro Equipment Corp**, Bryan, Ohio.—AVIATION, *Oct.*, '43.



Make GRAYBAR Your DELIVERY CONSULTANT



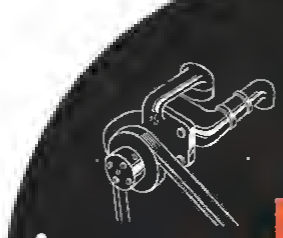
on ELECTRICAL supplies you build into your planes

• Your local GRAYBAR Representative can relieve you of detail and follow-up on the delivery status of hundreds of different electrical items . . . especially the production items used in the wiring systems of your planes. A single contact "via GRAYBAR" carries through to leading electrical suppliers all over the country. Delivery schedules can be coordinated on all the electrical products that go together in use. For this *specialized* aircraft service, just call GRAYBAR.

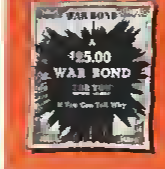
BATTERIES
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IN OVER 80 PRINCIPAL CITIES
Executive Offices: GRAYBAR BUILDING, NEW YORK 17, N. Y.

WIN A WAR BOND .. tell why



dag COLLOIDAL GRAPHITE
REG. U.S. PAT. OFF.
IS IMPORTANT in the Manufacture or Use of Each of the 4 Items Illustrated



HOW TO WIN

Acheson Colloids Corporation will give a $25.00 War Bond to each of the 5 people who submit complete and accurate answers together with the 5 best letters on the question, "Why is **dag** colloidal graphite important in the manufacture and/or use of each of the products pictured here?" (1) State business connections (no one in the graphite field or their families is eligible) (2) All entries must be legible. (3) All entries must state the publication in which the advertisement was seen. (4) Entries must be postmarked not later than November 15, 1943. (5) In case of ties, duplicate awards will be made. (6) Entries become the property of the Acheson Colloids Corp. (7) The verdict of the judges will be final.

dag COLLOIDAL PRODUCTS
ACHESON COLLOIDS CORPORATION
PORT HURON MICHIGAN

dag
Colloidal Graphite Keeps Metal Parts from Sticking Together

The studs or bolts which hold the cylinder head of a gasoline engine after a period of use are apt to stick so tightly that it is necessary to drill them out when they have to be removed—this due to the heat of operation and corrosion. Lamp bulbs subject to the salt air near the sea or to chemical vapors often stick in their sockets so tightly that they cannot be removed without being destroyed. The same is true of pipe threads, gaskets, deep-sea diving equipment and aviators' oxygen helmets—in fact, any metal-to-metal contact subject to heat and corrosion.

All this difficulty can be eliminated by treating screw threads and metal surfaces with **dag** colloidal graphite when they are assembled. Tighter connections are thus available and sticking or freezing are prevented.

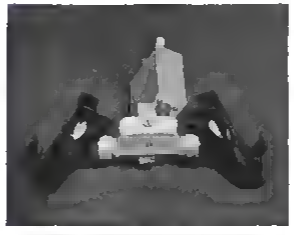
dag colloidal graphite is also used to keep molten glass from sticking to glass molds and to facilitate the removal of adhesive from machines used to manufacture corrugated box-board.

*Write for Bulletin 422H on the use of **dag** Colloidal Graphite as a Parting Compound. This bulletin discusses **dag** Colloidal Graphite for screw threads, lamp bulbs, its application to aviation and deep sea diving equipment—also its use in the glass industry, in the foundry, and in the rubber industry.*



FLEETWINGS

pioneers with parts and hydraulic equipment



B-2 J2 Gun Turret Valve built for the U. S. Army Air Forces

READY! AIM! Fleetwings has developed an eighty-one ounce Gun Turret Valve that is a real lightweight stinger. The valve is small—fits readily into places where space is at a premium—literally "flies in" the gunner's lap without interfering with his leg room. It is engineered to eliminate variations in "load feel." The piston surface and sleeve bore are "mirror finished" by nitriding.

ON THE BEAM Fleetwings' engineering department has developed a Wing Chord Divider Beam that should interest any aircraft wing draftsman. It is easy to construct, yet it can save approximately 75 per cent of the time usually required for calculating and layout work. The Wing Chord Divider Beam takes over so many of the operations necessary for laying out a wing contour that using it is like having an assistant working with you. If you'd like to build one yourself, write for the August issue of "The Arrow." "Fleetwings' pocket-sized monthly magazine.

Fleetwings' illustrated magazine "The Arrow" is yours, each month...for the asking. You will find it a gold mine of production ideas and time-saving suggestions. Write for it on your company stationery. Address "The Arrow," Fleetwings, Bristol, Pennsylvania.



FLEETWINGS

Division of Kaiser Cargo, Inc.

BRISTOL · PENNSYLVANIA

Propeller De-Icer 68

Developed by Wright Field and Dr Louis Marick (photo) of U. S. Rubber Co., New York City, new device to prevent formation of ice on propeller



blades employs a conducting rubber known as Uskon attached to blade leading edge. Through addition of certain chemicals, rubber is made to conduct electricity, thus generating enough heat to prevent icing—AVIATION, *Oct.*, '43.

Sealed Switches 69

Bakelite switch cases sealed to keep out dirt, dust, and oil are announced by **Allied Control Co.**, New York City, to have these characteristics. Contact arrangements single pole, single throw; contact ratings, noninductive, 50 amp at 12 and 24 v., d-c and 110 v. a-c, plunger travel differential .006 to .012 in.; over-travel .050 to .070 in. at max pressure, vibration 10 G horizontal or vertical, weight 5 oz., dimensions 1⅛x1⅛x1⅛ in.—AVIATION, *Oct.*, '43.

Airplane Jack 70

Features incorporated in mechanical jack for lifting planes when servicing wings and landing gear, says **Duff-Norton Mfg. Co.**, Pittsburgh, include wheels of 6 in. dia. for moving jack from place to place, steel screw raising mechanism, safety lock to prevent accidental lowering, and governor on lowering mechanism with thumb screw for controlling descending speed. With capacity of 18 tons, jack is 44 in. high when closed, 76 in. when raised.—AVIATION, *Oct.*, '43.

Fuse Post 71

Electric welding of side terminals to metal shell of fuse extractor posts has been found to form a connection which vibration will not loosen, according to

NEW PRODUCTS

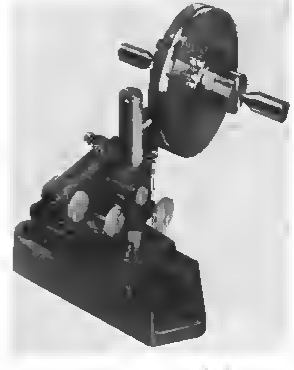
Littelfuse, Inc., Chicago. Company's new post for radio, relay, rectifier, and other circuits up to 15 amp. has black bakelite molded body and knob, latter holding fuse. Special grip keeps fuse from dropping out. Other features permit screwdriver or finger operation, visual inspection of fuse, and protection against leakage.—AVIATION, *Oct.*, '43.

Drill Chuck 72

Changing drills, countersinks, and other tools while motor is running is possible with new chuck by sliding back an outer sleeve which releases a centrifugal lock. When new tool is inserted sleeve is snapped back into position. Centering is designed to be automatic and positive, and adapters are available for drill sizes from ⅛ to ⅝ in., letter sizes A to K, and wire drills from 1 to 60. Manufactured by **R. M. Wright Co.**, Royal Oak, Mich.—AVIATION *Oct.*, '43.

Division Tester 73

For checking spacings in gears, camshafts, index plates, or other circular parts new division tester designed by **Ingis Equipment Co.**, Chicago, consists of master circle and microscope units. Part to be measured (outline in photo) is attached to master circle, which is centered by radial screws and dial indicator. Set and focused by rack and pinion, microscope gives complete reading within eyepiece.—AVIATION, *Oct.*, '43.





for producing "AN" Standard Fittings

Producing fittings for tubing and pipe has been Grinnell's job for over 60 years.

The specialized skill built up over these many years plus up-to-the-minute production equipment enables this company to offer the finest facilities for supplying "AN" fittings in war-demand quantities.

We may be able to help you. Write Grinnell Company, Inc., Executive Offices, Providence, Rhode Island.



GRINNELL

WHENEVER PIPING IS INVOLVED

Plants, Branch Warehouses and Sales Offices in Principal Cities

Countersink Setter 74

Micrometer stop countersinks are being produced by **Aero Tool Co.**, Burbank, Calif., with split keepers which give positive set to retainer collar bear-



ings. Thus locking is designed to prolong accuracy, compons stating vibration will not loosen bearing retainer and thus damage tool or material. Force is directed evenly toward center of shaft, and unit can be taken apart by hand.—AVIATION, *Oct.*, '43

Cable Splicer..... 75

Improved design wrought iron cable splicer with manganese bronze fittings is announced by **Machanics Engineering Co.**, Jackson, Mich. Bushings and thimbles are held in jaws by a sprocket chain and adjustments in chain are made by setting and locking a button. Bulging is controlled by chain as splicer is tightened around bushing. Splicer can be bolted to bench or held in hand or vise.—AVIATION *Oct.*, '43

Gyro Transformer..... 76

Designed specifically to permit simultaneous operation of gyro-horizons and directional gyros, new single- to three-phase transformer can be used on planes with 400-cycle, 115-v. single-phase inverters. From inverter's single-phase input, it provides necessary three-phase operating current. Manufacturer, **General Electric Co.**, Schenectady, says it will bring gyro motor to full speed in 1½ min at 25 deg C. Dimensions are 2⅛x2⅛x2⅛ in. and weight 8 oz.—AVIATION, *Oct.*, '43

Writing Tool 77

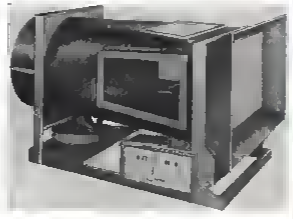
About size of a fountain pen, electric writing tool made by **Brener Electric Mfg. Co.**, Chicago, can be used for marking brass, glass, plastics, wood, hard rubber, aluminum, steel, and bronze. Used like a pencil, it operates from 115-130 v., 50-60 cycle a.c. power and is adjustable for deep or shallow cuts. Models are available for light or heavy work.—AVIATION, *Oct.*, '43

Aircraft Motors..... 78

U. S. Electrical Motors, Los Angeles, announces development of line of high frequency electric aircraft motors with flanges for mounting on pumps, blowers, actuators, and other equipment. Operating on three-phase alternating current of 400 c., various models deliver from ¼ to 15 hp. Motors can be provided with intermittent and continuous duty ratings and synchronous speeds of 6,000, 8,000, and 12,000 rpm; lower speeds are possible through integral gears. Housings are magnesium alloy and windings stationary.—AVIATION, *Oct.*, '43

Classroom Wind Tunnel..... 79

For classroom demonstration, model wind tunnel has conventional honeycomb to straighten airflow, side windows for



viewing performance of part being tested, and means for statically balancing model after which forces, automatically counterbalanced, are indicated in ounces on lift and drag dials. Models can be set for various angles of attack. Measuring approximately 26x27x41 in., tunnel is supplied with special propeller which can be driven by 1,750-rpm. ¼- to ½-hp. motor, or wind can be supplied by any 16-in. electric fan. Made by **Comet Model Airplane & Supply Co.**, Chicago.—AVIATION, *Oct.*, '43

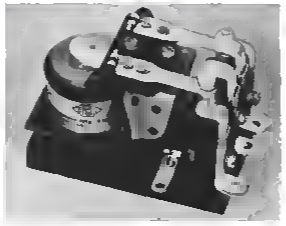


Welding Flux **80**

New flux, 16 GH, for specialized welding of thin gage strips, sheets, tubes, etc., of stainless steel and other high alloy chromium bearing metals is announced by **Solar Aircraft Co**, San Diego. In addition to higher melting point, 16 GH is stated to have improved adhesive quality and to help prevent oxidation and carbon pick-up. Tests indicate that it protects rod from oxidation and that it can also be used to promote metal flow on stainless steel and other high chromium welding rods. Flux may be applied several hours before welding and holds fast despite frequent handling without use of shellac. It qualifies under appropriate Army and Navy specifications and is suitable with most welding processes including oxyacetylene, atomic hydrogen arc, metallic arc, and heliarc.—AVIATION, *Oct.*, '43.

Shock-Proof Relays **81**

Series SP radio and aircraft relays designed to withstand shocks and vibration



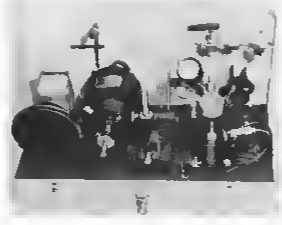
have armatures to operate in any position. Steel armature frame and core are heat treated after fabrication. Bakelite molded base measures 2¾x1 1/12 in. Steel parts are cadmium-plated, and contact springs tinned or silver-plated. Direct and alternating current models are manufactured by **Potter and Brumfield Mfg Co**, Princeton, Ind. Non-induction load is 5 amp at 110 v., 60 cycles.—AVIATION, *Oct.*, '43.

Rheostat Assemblies..... **82**

Combinations of rheostats made up in tandem and mounted on steel frames by **Ohmite Mfg Co**, Chicago, range in capacity from 25 to 1,000 w. and diameter from 1 9/16 to 12 in. They are insulated for controlling several circuits simultaneously or phases of one circuit through single knob. Concentrically located knobs permit separate operation of two rheostats in cases where one is used as a vernier for other or where necessary to conserve panel space. Tandem rheostats are also manufactured with taper windings and same resistance ranges as individual units.—AVIATION, *Oct.*, '43

Spark Plug Tester..... **83**

Self-contained portable spark plug tester consists of hand or motor driven magneto, gap setting tool, and hand operated pressure test bomb, latter supplemented by small detachable bottle of carbon dioxide said to make possible checking over 1,000 plugs without refilling. Electric motor is ¼ hp., 110 v., ac. With gages, adapters, wrenches, and forming and adjusting tool—also fur





ACW Alloy Bars

in Ryerson Stocks

• Aircraft quality 8630–X4130–4140 alloy steel bars—hot rolled, cold finished and heat treated—in a wide range of sizes—are carried in stock for immediate shipment from Ryerson plants at Chicago, St. Louis, Cincinnati and Jersey City. These steels conform to specifications AN-S-14, AN-QQ-S-684, and AN-QQ-S-752 respectively and are readily available to aircraft manufacturers and their subcontractors under the ACW program. A special booklet of stocks on hand, "Aircraft Alloy Steels," will be sent to you on request.

Other steels at ten Ryerson plants comprise over 10,000 different kinds, shapes and sizes—everything in steel. Call your nearby Ryerson plant first—for quick action on steel. Joseph T. Ryerson & Son, Inc., Steel Service Plants at Chicago, Milwaukee, St. Louis, Detroit, Cleveland, Cincinnati, Buffalo, Boston, Philadelphia, Jersey City.

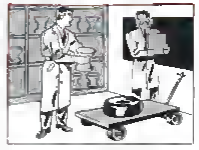
RYERSON STEEL-SERVICE

Buy Tail Wheels...Tail Wheel Tires & Tubes

THE GENERAL WAY*



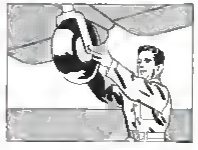
The Old Way — Tires, tubes, wheels bought as separate units require extra, wasted housing space, extra inventory and stock records.



The Old Way — means lost time in obtaining assembled tail wheel units from separate storage spaces.



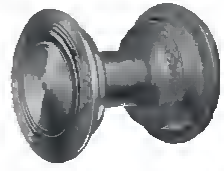
The Old Way — necessitated assembly of tail wheel units—waste motion!



General's tire tube wheel combination eliminates wasted time. Can be stored in one place . . . is ready for installation!



***IN ONE PACKAGE!** When you buy GENERAL'S tire tube wheel *combination* you eliminate need for extra storage space . . . avoid unnecessary inventory . . . save production and maintenance time, cut costs and at the same time get the *quality* design that counts!



GENERAL Military and Commercial type tail wheels are fabricated from aluminum or magnesium alloy castings. Precision machined . . . fitted with tapered roller bearings. Both tapered and straight axles. Designed and built to A-A-F Spec. No. 25272. (Easily removable dust-proof cover equipment.)

The General Tire & Rubber Company's *complete* ahead-of-the-field line of military and commercial type tail wheels is backed by General's long, practical experience in the manufacture of aircraft wheels, brakes, tires and allied aviation products . . .

General tail wheels are *rugged*, built to take as much abuse as main landing wheels . . . yet they're *light—for increased payload!*

Designed to meet Army, Navy and C. A. A. specifications . . . General tail wheels and tires alike have *proved* their superiority in action on every type of aircraft and in tests run at General's own completely equipped laboratories as well as in extensive tests by leading users.

A case in point was the way the General Twin-Bead tail wheel tire stood up . . . where single bead tires failed . . . in sideload tests run by a large, eastern aircraft company. General's Twin-Bead feature provides *extra-grip* on the wheel rim!

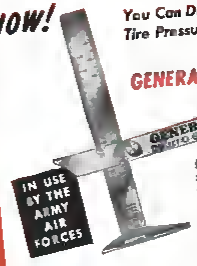
So it's good news that today General has production facilities available for immediate delivery on General tires, tubes and wheels. *For further information write or wire—Aviation Division*

TWIN BEADS

THE GENERAL TIRE & RUBBER COMPANY • AKRON, OHIO



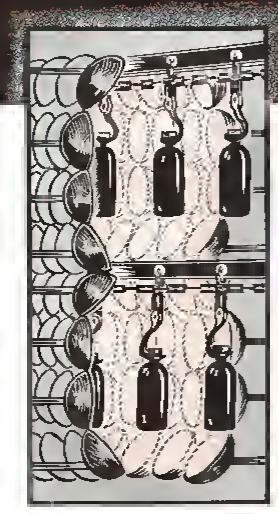
NOW! You Can Determine Correct Aircraft Tire Pressure in Just 60 Seconds . . . with the **GENERAL DEFLECT-O-GAUGE**



With the General Deflect-O-Gauge, each tire can be inflated to exactly the *correct pressure* required for the load. No graphs, charts, use of scales or air pressure gauges necessary . . . simply use the General Deflect-O Gauge and air hose! Write now for free instruction folder. Address Aviation Division, The General Tire & Rubber Co., Akron, Ohio

6 YEARS' Production IN 1 YEAR!

... with 10% Less Help



★One of our customers was striving to produce more oxygen cylinders for the Army and Navy. Floor space limitations had set a production ceiling of (censored) per month. The finished cylinders had to be painted, and the paint allowed to dry.

A Lamson engineer, working with company officials, suggested two Overhead Conveyors, realigning their operations and installing Infra-red drying *overhead*, there being no room elsewhere. They are now getting six years' production in one—with less clutter on the floor—*and with 10% less help!*

LAMSON CORPORATION

SYRACUSE, N. Y.

Makers of CONVEYORS and PNEUMATIC DISPATCH TUBES

nished by maker, **Airplane Mfg. and Supply Corp.**, North Hollywood, Calif.—unit including portable metal box weighs about 80 lbs.—AVIATION, *Oct.*, '43

Engine Heater 84

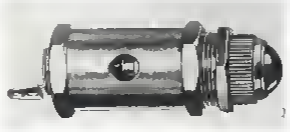
Carried like a suitcase, 38 lb. portable engine heater made by York Heat Div., Thos. Shipley, York, Pa., produces 90,-



000 Btu. per hr. from high test aviation gasoline. It is stated to make possible starting of 2,000 hp. engine at –20 deg. F. in 15 min.—AVIATION, *Oct.*, '43

Pilot Light 85

For grounded panels, new series of pilot lights are about 2 in. long and can be mounted on 1-in. centers. Bulb can



be changed by unscrewing jewel holder. Light is ventilated and available with plane or faceted jewels from **Gothard Mfg. Co.**, Springfield, Ill.—AVIATION, *Oct.*, '43.

Battery Charger 86

Among types of battery chargers made by Selenium Rectifier Div., **Federal Telephone and Radio Corp.**, East Newark, N. J., are low voltage models for aircraft. They are portable, have a wide charging range rate control, and can be provided with switches for shifting from 6 to 12 v. Rectifier unit automatically reduces charging current as battery voltage increases.—AVIATION, *Oct.*, '43.

KICK THAT "POP-OFF" MECHLIN OUT!



"Mechlins" are trouble makers for men who handle wrenches. And, mister, here's a "Mechlin" who gets in more than his share of dirty work.

The gent we're exposing is "POP-OFF", so dubbed because he's in there pitching to have sockets and attachments fall off ordinary wrench handles.

And man — when a socket pops off into hot machinery, or a complex assembly — or onto workmen below — there's trouble and damage ahead and the air is blue!

"POP-OFF'S" ENEMY IS BLACKHAWK'S "LOCK-ON"

There's no need to put up with this trouble. Enjoy the great advantages of detachable, interchangeable socket wrenches *without worrying about combinations coming apart accidentally!*

Blackhawk Socket Wrenches are unlike ordinary wrenches. They have a patented, built-in device called "Lock-On" that clicks sockets, handles and attachments into rigid combinations. No set-screw devices or friction grip! Then, to disengage — simply press a small built-in button with your thumb, and pull. For speed and safety's sake insist in having these features.



***A Product of* BLACKHAWK MFG. CO.**
Department W21103 Milwaukee, Wis



AVIATION MEN have quickly recognized the importance of Lock On. Nothing exasperates a workman more than when he must fumble in hot machinery, tear down an assembly or finger around in an oil pan — *just to find a socket!* "Lock-On" prevents these delays.



COMPACT BLACKHAWK WRENCHES get into cramped quarters — and when you pull out — *the socket is not left sticking on the nut* — thanks to "Lock-On"! What would happen to your knuckles if you tackled the above close-quarter job with anything but a ratchet and socket?

MEET THE MECHLINS
There are other "Mechlins" as troublesome as Pop-Off — and they're all described (with antidotes) in this little booklet for plant superintendents, production supervisors, engineers, maintenance and assembly men and mechanics. Get this book from your Distributor, or mail the coupon TODAY.



BLACKHAWK
WRENCH SPECIALISTS

BLACKHAWK MFG. CO.
Dept. W21103 Milwaukee, Wisconsin
Rush your free booklet
MEET THE MECHLINS —and new wartime wrench catalog

Name .....

Company .....

Address .....

Corsair...ALTITUDE



With its highly supercharged 2,000-horsepower engine, the Navy's Vought Corsair operates at extremely high altitudes. From this commanding position, Corsair pilots are pouncing on the enemy with deadly effect.

CHANCE VOUGHT AIRCRAFT

STRATFORD, CONNECTICUT

USE OF THIS FORM DIVISION OF UNITED AIRCRAFT CORPORATION

BLAINE STUBBLEFIELD Washington HERB POWELL New York

Eight Washington Agencies Have Another Try, But Manpower Shortage Is Still to Be Solved

Washington (AVIATION Bureau)—The West Coast War Manpower Program promulgated Sept. 15 by War Mobilization Director James F Byrnes, apparently is already doomed according to both government and industry officials (An analysis of the program appears on page 110 of this issue)

Washington's effort to extricate production goals from a crisis which was foreseen has resulted in a mass of orders and schemes that change daily A careful reading of the Byrnes directive however, shows that C E Wilson, executive vice-chairman of WPB, is boss in the West Coast situation, just as he is in the over-all aircraft program He can follow the Byrnes program or not. The industry has confidence in him His greatest handicap is that the White House saw fit to step in and write the directive which appears to be a corrective measure taken over his head

Actually, the seeds of this trouble were sown before Mr Wilson's time Most accepted opinion is that too much of the war program is on the Coast. One prospective remedial measure is to move some of it out.

Principal objections of the industry to the new program are that eight different federal agencies are involved, that there is no single agency to which manufacturers may appeal for final decision, and that the vital problem of labor turnover as yet remains unsolved

Main objective of the scheme is to combine federal authority (up to a point) with local knowledge through creation of Area Production Urgency Committees comprising both federal agency and community representatives War Manpower Commission is given responsibility for supply and distribution of labor while the War Production Board is charged with adjusting production programs to available labor

OWI Issues Summary Of ASC Operations

"At the start of the final phase of the Tunisian campaign only 19 AAF planes were kept out of combat for lack of parts," the OWI reveals in a summary of the work of the Air Service Command 'ASC's present overseas record," OWI continues, 'is approximately 5 percent of our planes grounded for lack of spares"

Among ASC's duties OWI lists the supplying repairing, overhauling of all AAF planes throughout the world; the training of personnel; the preparation of planes for shipment overseas (as a rule fighters are shipped)', the final inspection and modification of planes flown overseas; the final inspection of Lend-Lease planes consigned to Central and Latin America; and the carriage of cargo by the 36th Air Freight Wing which loads Transport Command planes and operates to 117 points along the Army's 50,000-mi transport system in the U S

'We are in a sense the guardians," says the commanding officer, Maj Gen Walter H Frank, "of the men who wear the silver wings '

This task has resulted in the creation of "11 main supply and maintenance depots and some 300 subdepots and specialized depots in this country and numerous similar installations in the theaters of operation," OWI says. 'Personnel consists of approximately 300 000 civilians and tens of thousands of officers and enlisted men' Among their jobs with ASC, which was seperated from the Materiel Command and activated as a separate AAF branch on Oct 17, 1941, are the warehousing and handling of some 400 000 separate items of maintenance and repair—ten times the number listed in a large mail order catalog—for the 143 types of aircraft made in this country, and the reporting of unsatisfactory plane parts and characteristics These reports are issued as three types of technical orders' 'Immediate,' 'As Soon as Possible," and "As Soon as Practicable" The first two types must be made before a plane can be sent overseas.

Marshall Says Bombing May Be "Decisive Factor"

Anglo-American air attack on Germany "gives promise of being a decisive factor in the ultimate destruction of the German citadel," says Gen George C Marshall, Army Chief of Staff, in his biennial report to the Secretary of War.

He reports that the "violence of the German fighter reaction to our daylight attacks is convincing evidence" of their results. "The enemy must find a counter to this technique or accept the emasculation of his industries and his fighter command"

The General's report discloses that on July 1 more than 1,000 heavy bombers were based in Great Britain. Their attacks, he states, have forced the enemy to increase production of fighters at the expense of bombers and withdraw planes from the Russian front for the Western front

"The net result was that the Germans were unable to conduct any sustained offensives this summer in Russia or build up sufficient strength in the central Mediterranean to oppose the Allied offensive"

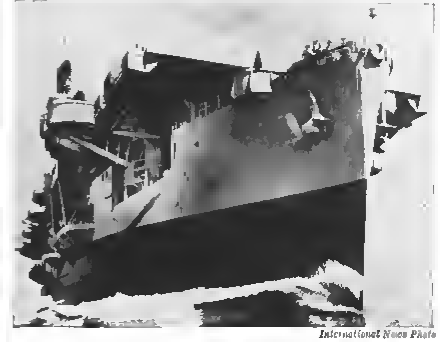
Our war on the Japs is accompanied by heavy destruction of their ships and planes "This attrition must present an appalling problem for the enemy high command."

AAF service units, he said, have expanded about 12 000 percent and the air forces proper about 3 500 percent

WTS Contract Relief

As much relief as possible will be given War Training Service contractors from inequalities of the contractual and license clauses and renegotiation will be employed in rectifying losses, National Aviation Training Assn understands from John P Morris WTS director who addressed the organization's recent Chicago region meeting

CAB Chairman L. Welch Pogue has been announced as speaker at the association's national convention Dec 2-4 in St. Louis



International News Photo

ESCORT TO SAFETY

On its trial run before going into anti-submarine service this is one of Navy's escort aircraft carriers which have been "built in dozens" They are adapted from hulls originally designed for merchant ships or naval auxiliaries

Aviation Curbing Enemy Land and Sea Power; Arnold Drops Hints on Coming U. S. Bombers

Washington (Aviation Bureau)—Superiority of Allied aviation now secure on all war fronts, seems to be the main reason for increasing weakness of both Japs and Germans on land and sea.

Gen. Marshall, Army Chief of Staff, says the Nazis were unable to sustain a strong offensive on the Russian front because they lacked fighter strength.

An INS dispatch from Britain quotes top AAF officers as estimating that only 25 percent of Germany's single-engine fighters are in the East, that 55 percent are opposing the Allies across the Channel, and that the rest are in the Mediterranean theater.

Bulk of the Italian fleet escaped because the Germans did not have enough aviation to stop it, Col John Jestyn Llewellin, chairman of the British Supply Council, said in Washington recently that the Italian surrender ultimately will enable the Allies to double the weight of bombs dropped on southern Germany.

At a recent press conference in England, Gen. Arnold said that Hitler can have no hope of moving his war industries out of reach of our heavy bombers. He indicated that our two new super-heavies would be in the fight in the "near future." They will dwarf our present *Flying Fortresses*," he wrote in *Army Ordnance*, and be able to carry a bomb load across the Atlantic and then return without stopping. It is reported that they will be built by Boeing while Consolidated will continue to concentrate on *Liberators*. The new planes Gen Arnold pictures will bristle with multiple-gun turrets controlled from sighting stations.

The AAF chief warned airmen to expect new resistance tactics from the Germans who are now desperate. In reply, he said, we would use "cannon rockets" or whatever is necessary to get the target. This could mean a sort of rocket "bazooka" which would throw missiles a considerable distance ahead of the bombers.

The Nazis recently tried a type of saturation defense. Their fighters came at our bombers wing-to-wing, hoping to smother the attackers in concentrated fire and get in close enough to cut down the Allied planes. Resulting high losses to the enemy indicated the tactic was not successful.

According to General Arnold, our new heavy bombers will be used first, not against Japan as previous opinion had indicated, but against Germany.

A new high rate of releasing bomb tonnage was set in a recent attack on Berlin, when 1 000 tons were let go in 20 min. One-thousand plane raids are still only occasional, more than a year after the first one, but load capacities have been augmented.

AAF officials in England claim that it alone is sending 3 000-man attacks into the air, tieing up 1,000,000 men on Nazi A-A guns, radio locators, and other necessary defense and putting 10 000 000 people on the alert and off their jobs.

The Japs have put a new fighter in the field, succeeding the *Zero*, with heavier armor, more powerful in-line liquid-cooled engine, and more guns. It somewhat resembles the P-40 and P-51, but has a stubby nose.

Since the Marcus Island attack by our Navy, nearest hit yet since the bombing of Japanese cities, opinion is that our powerful carrier force will soon dash in at vital points in the Nippon empire, without waiting for bases in China. At the same time, the Allies are building up a steamroller drive that will go into China by way of the Burma back door, with gasoline and other supplies to operate bases in China. Until that is done, no effective number of aircraft can be accommodated by the Chinese.

Canadian Notes

By James MacFagnes

Latest report shows that strength of the RCAF is now more than 200,000, including nearly 13,000 in the Women's Division, as compared to a total prewar enrollment of 4 000.

RCAF aircrews serving with RAF squadrons form 25 percent of the latter's flying strength. This does not include RCAF squadrons operating in the United Kingdom and elsewhere. There are 32 all-Canadian squadrons already organized and six more being activated. For every RCAF aircrew member in a Canadian unit overseas there are now eleven in RAF units. The proportion of RCAF to RAF will increase rapidly according to Air Marshal Harold Edwards, commanding the RCAF overseas. Projected average strength of RCAF home establishment during the fiscal year ending Mar. 31, 1944, is approximately 35,000.

Production of the Avro *Lancaster*, deHavilland *Mosquito*, and Curtiss *Helldiver* will increase steadily, says a report by the Department of Munitions and Supply. Parts of the Canadian *Lancaster* have been made interchangeable with those made in Britain through use of optical instruments in aligning dies. Dominion manufacturing industry is working on nine types of aircraft and, later this year, expects to be building a trans-ocean cargo plane. Design of a four-engine transport has been begun.

Aircraft factories and component parts plants now employ over 100 000 workers, more than 25 percent of them women. Strategically located overhaul shops recondition 200 planes and 800 engines every month. The manpower market, however, is tightening. Boeing, Ltd., which employs nearly 9,000 men and women in Vancouver, is considering establishing branches in British Columbia to secure 1,000 more workers to complete its $100,000,000 in orders.

Trans-Canada Air Lines reports July express poundage more than doubled to 73 634 lb. compared to July 1942. Passengers increased from 9,-440 to 13,468 during the year and mail from 192,971 to 316,-547 lb. Third daily flights have been inaugurated on the New York-Toronto and Montreal-, Toronto-, and Ottawa routes.

Government's National Research Council, reporting on activities since the start of the war, mentions use of exhaust heat in propeller, wing, and windshield de-icing. Much work has also been done on the substitution of molded plywood for duralumin end steel, resulting in extensive use of wood in the Avro *Anson* and deHavilland *Mosquito*. Soma promising compounds were also found for reducing the deposit of frost on grounded planes.

Pilots under 40 yr of age employed by companies making up Canadian Pacific Air Lines now have a compulsory pension scheme. The monthly contribution is 5 percent of the salary deducted at the source. Retirement is set for 60 yr, but can be made applicable at 55. Pension payments will be based on average earnings over period of service, or on the average for the last ten years, whichever is higher.



DOUBLE QUICKING THE BT'S

Tail first, BT-15A basic trainers are hauled along moving final assembly line at Consolidated Vultee's Downey, Calif., plant. It's said that line is world's fastest.

★ SPOT CHECKING ★

Annual savings of 150,000,000 ft of lumber per year worth $7,-900,000 is announced by the Materiel Command, Wright Field, to have resulted from its returnable engine crate program.

Substitution of resin impregnated plywood for duralumin in pilot's escape hatch doors on **Liberators** is announced by Tucson Div of Consolidated Vultee. Similar change had previously been made in waist gunners' doors.

Approaching a city by train says John Kieran, N. Y. Sun columnist, "is like entering a fine building through a coal chute and washing the living room by way of the cellar. Answer: Come into the city by air."

More than 200 model airplane manufacturers in this country are making $10,000,000 worth of miniature military craft this year. Some are doing 40 times their 1942 business. Model Industry Assn. has formed a committee to recommend educational requirements in model plane assembly kits.

Reduction in armament prices by International Harvester Co including 20-mm aircraft cannon is announced by the company to have saved the government more than $10,000,000.

Decentralization of cities will be one of the effects of postwar aviation, Paul R. Williams, architect, told a recent Los Angeles meeting of the American Society of Tool Engineers.

Convair's Nashville Div. has found that of 3,500 people it has trained in the last two years 40 percent had never been previously employed in industry and many had never even been in a factory.

Distinguished Service Medal has been awarded to Col. Benjamin S. Kelsey of Wright Field for contributing "more than any other individual to the advanced engineering development of the U.S.A." Without his untiring effort, courage, and faith this aircraft would not have attained its present state of military utility."

Petroleum Administration for War has established special division to further expand aviation gasoline refining capacity. Ultimately 100-octane production is scheduled from 120 U. S. refineries; more than $500,000,-000 government money has been traveled and 188 construction projects approved since last April.

Higgins Industries plans to enter the postwar civilian helicopter market with a machine designed by Enea Bossi. Pres. A. J. Higgins predicts it will be produced at standard-size automobile prices.

"Deplasmerization" of plastics is urged by the Society of the Plastics Industry, which points out that there have been too many Sunday supplement features which have characterized plastics as "the miracle whip" material with which anything can be done."



Official U. S. Navy Photograph

NIP BOMBER NIPPED

Camera caught this close-up of wrecked Jap twin-engine long range bomber —probably Mitsubishi 0 1—when American troops captured strategic Munda airfield in Solomons. Note bomb-scarred trees in background.

★ MILITARY MEMOS ★

Allied aviation has achieved decided mastery of the air over the English Channel and invasion coast of France, in one recent day 4 000 sorties (inverting 1 800 fighters and medium bombers) were flown, 4,000 of them by USAAF. Effect of raids was summed up by Correspondent Raymond Daniell to *The New York Times*: "The job of softening up Germany from the air for a land invasion is more than half done."

German fighter resistance however, is growing. Interceptor planes are carrying nose lights to blind Allied bomber crews and dropping curtains of flares on them from above. Allied leaders estimate the Nazis can put 400 fighters over the targets and the ranges to them. Estimates were available proving Germany *might* run out of fighters by Christmas; no one was taking any bets. AAF destroyed 671 Nazi fighters in August.

In the Mediterranean theater RAF barrage balloon crews were among the first to land at Salerno. They were soon supported by nearly more than 1 000 tons of bombs loosed in one day from *Flying Fortresses*, *Mitchells*, and *Wellingtons*. Summary of Sicilian operations shows we lost 1,001 planes in our 3-1 ratio of better than 6 to 1. *Mustangs* were organized into an air cavalry for patrol and skirmish work. The pilots raided 300 ft. high flying.

Shifts in command: Maj. Gen. Ralph Royce has succeeded Maj. Gen. Louis H. Brereton as commander of all U. S. Army forces in the Middle East. It was expected that Gen. Brereton would be given command of a European tactical air force. Washington announced appointment of Brig. Gen. Edwin S. Perrin as deputy chief of air staff. Brig. Gen. William Old has become chief of the First Air Command, according to a report from New Delhi, India. Brig. Gen. W. E. Larsou has assumed command of the Third Air Force with headquarters in Tampa, Fla.

Recently honored by War Dept. were Brig. Gen. Frank P. Lahm and Lt. Gen. Carl Spaatz. Legion of Merit: Brig. Gen. Nathan Bedford Forrest (listed as missing) 38-yr.-old grandson of the Confederate cavalry leader. Distinguished Service Cross: and Maj. Gen. James H. Doolittle. Distinguished Service Medal:

Maps showing target area just as it appears from an approaching plane have replaced usual vertical photos and charts to Eighth Air Force. For the newspapers Army has revealed existence of the automatic pilot used in precision bombing runs.

In the Pacific: Adm. Chester W. Nimitz estimates the Marcus Island raid destroyed 80 percent of the military installations. . . . Our losses totaled two fighters and one torpedo plane." Gen. MacArthur's air force is still said to be "modest" in size.

Navy has launched *Wasp VII* and *Hornet VII*, aircraft carriers, and adapted the *Mitchell* for anti-submarine work.

A "Messerschmitt" 109-G Germany's late model high altitude plane, has been winged at 30,000 ft. by three British anti-aircraft batteries.

The Washington Windsock



By BLAINE STUBBLEFIELD

Warm: A most estimable aeronautics laboratory was experimenting with engine heat for de-icing the wings. Engineers went up to watch it work. Things got too hot, the wings began to curl—and the engineers got down from there in a hurry.

First thing dean by the NACA's new helicopter committee was a check on the dictionary for correct pronunciation. Grover Loening, chairman, says it's *hell-ih*, not *heel-ih*. And so does Mr. Sikorsky, who ought to know.

Bad weather will be good weather in the next war. Improved aviation instruments and skill are making possible bigger raids during low visibility. Overcast blacks out the sights of flak gunners as well as those of the enemy fighters. Answer, it's said, is that everything will be "seen" with radio locators by that time.

Lacking at the list of proposed new air routes, we were amazed to observe that Enterprise, Ore., is left out. The CAB has been feeling harried about the flood of applications. Their troubles haven't started. Wait till the home town boys *really* get going.

A group of Senators told the Administration, in effect, that Congress would help write the international postwar air transport program. But the Executive is chief of foreign relations, and his office has more power than ever. The Administration leans toward a pro-British bilateral deal, Congress wants a multi-lateral world-wide setup.

Don't worry about the effect of such talk as the Truman report on pilot morale. A manufacturer of a fighter tells us that U. S. pilots are not afraid to fly any airplane. In fact, they complain unless they get to hop the hottest ones. One of them twisted an airframe in a manner unexplainable to any engineer—did it in the air. They forget to let down wheels, buzz-saw the runways with their props, then go back up. They do things with airplanes that designers never dreamed of.

Navy blimpmen are reporting schools of fish to fishermen. Another postwar job for aviation. Learn to fly a blimp! Be a fish finder!

First, Alaska mahara gave way to the barnstorm flyers. Now these mountain-top-contact airmen are also on their way out as the CAB prepares to move in with an administrative office. Twenty-one operators recently granted certificates are doing important military work, and some may get additional airplanes. Alaska, Hawaii, and Puerto Rico are all under U. S. domestic air regulations.

England's reply to the free competition policy expressed by the body of U. S. airlines is that not one of the European countries among the United Nations will be in a position to compete for some time after the war due to "sacrifices made in the common cause." This reply is made by the Joint Air Transport Committee, which recommends instead that each country have its fair allotted quantum of airways, and that England and the United States have parity, in terms of a mutually acceptable yardstick.

Caterpillar Club Down to Mundane Farm

After 22 yr of the etherial freedom of no meetings, dues, or obligations the Caterpillar Club organization of flyers who owe their lives to parachutes, has set up a permanent ground organization. The move is sponsored by Milton H St Clair parachute engineer and one of the clubs founders, Stanley Switlik parachute manufacturer, and a group of unnamed trustees to take care of the large number of flyers who will qualify for membership during the war.

New Air Youth Award

The National Aeronautics Assn has announced the $10-000 Brewer Trophy to be awarded anually for "achievement in the field of air youth education" The fund covers three distinct annual awards —a national trophy which may become the "Junior Collier" an Alabama state-wide award and a local Birmingham competition

These awards, which will also carry yearly honorariums for the winners were made possible through a donation by Frank G Brewer of Birmingham who thus honors his two sons one a bombardier and the other a paratrooper.

★ Calling Names ★

Harold E Read, former Cessna production manager joins Engineering Laboratories Inc as vice president in charge of production

William L Schraeder production asst to V I Kelleti of Kellett Aircraft has been named general factory manager in addition to his other duties

E Edwin Jenea is named flight supervisor for Consairway

Nat Peschall assumes new duties as manager of transport aircraft for Douglas Aircraft. **Gordon Brown** will devote full time to directing activities of a new department of market research

30 Years for Navy Air Arm

As naval aviation marked its 30th birthday Secretary Knox's department reported that this service — fastest growing segment in the nation's air power building program'—now has more than 18 000 planes in "the most powerful naval air force in the world" One of the special achievements,' says the Navy is the *Hellcat* carrier fighter (see p 223)

Naval aviation got underway Oct 9, 1813, when Acting Secretary Franklin D Roosevelt appointed a board to draw up plans and specifications



1st motional News Photo

"MITCHELLS" WITH RAF

Decorated with British insignia North American B-25 "Mitchell" medium bombers are now being used in RAF daylight raids With two 1,700 hp Wright "Cyclones" and crew of five, their top speed is 300 mph plus

tral economic Planning **Bob Askew** will continue in charge of combat plane export and foreign business **Ben O Howard,** recently appointed assistant to Donald Douglas will act as consultant to Paschall and Askew

E N Lauranos is appointed works manager of Consolidated Vultee's Miami division

Walter D Peck transfers in the executive staff of Pinagra's South American headquarters at Lima

New United Air Lines changes are as follows **Charles W Field** is named Chicago asst to director of personnel and **H W Furman,** who has been in charge of Selective Service matters is named as his successor **Clara M Parker** is appointed woman counselor in the East and Mildred **R Haward** in the West **R K Moore** succeeds **E Van Voehten** as general purchasing agent **John J Herl** is named postal representative in Washington **Karl P Hughes** will handle traffic activities on the company's new direct services **W A Bouve** becomes station manager and **Richard F Dorsay** will assist him **Samuel T McDermett** is named passenger service manager with **Richard Rupp** as assistant **Robert E Johnson,** director of advertising and publicity is on leave as a lieutenant (jg) in the U S Naval Reserve **S P Lott** is named director of design handling and airports of Chicago and **Frazier S Wilson** is named insurance manager **E C Thomas** transfers to San Francisco on a new executive position **Cyril C Thompson** public relations v-p was awarded honorary degree of Doctor of Laws by Parsons College Iowa for his contributions in the development of air transportation and continued leadership in that field **Lt Col D R Fally** one-time supt of flight operations at Denver had the distinction of piloting the first transport plane to unload paratroopers over Sicily When VAL opened its direct to Washington service **Capt R Hamilton Lee,** dean of pilots returned to the Capital—2 yr after he flew in the nation's first airmail service out of Washington

William M Stebler is named service manager of American Propeller Corp

Calvin K Townsend is new assistant general manager of Aircraft Accessories.

Thomas H Corpe has been made vice president and general manager of Jordanoff Aviation

C N Crockar is appointed division treasurer of Consolidated Vultee's Nashville division **R E Brown** transfers to the post of works manager at the Allentown division

Ralph C Rogers is named factory manager of Republic Aviation's Evansville plant and **Charles J Hodge** asst director. Industrial relations at Farmingdale **C Hart Miller** is appointed divisional manager and **Don M Parker** will replace him as director of the military contracts department **J Sawyer Wilson** is named training manager **Howard E Richards** employment manager and **Donald W Fellerson** assistant director Industrial relations for the night shift

Edith Juell, member of TWA's public relations staff for the past two years has been named corporative advertising manager for the line

George A Evans, formerly liaison engineer of Fairchild's Burlington plant is named chief engineer succeeding **Lee H Worley** who resigns because of ill health **N V Kritzner** is named director of procurement of production planning division **Al Rogerstown J T Ogle** and **George W Dress** are appointed assistant service managers **Kent Bradford** continues as manager of the service division **J K Sterling** transfers to Burlington **Glen Evins** is manager of contracts and service department for both plants **Al Ranger Everard M Lester** becomes assistant general manager and is replaced as asst chief engineer by **C P Sanders Paul Battilana** is promoted from service manager to asst manager of contracts

Fred O Field is new director of industrial relations at Adel Precision Products and **Kenneth Gleed** is named personnel manager

Eldan R Campbell joins Massachusetts Mohair Plush

James L Bancrail is appointed commercial research director of Interstate Aircraft.

R O Smith is now asst supt of maintenance for Pennsylvania Central

Eugene A Roberts, research engineer of Firestone Tire & Rubber was given WPB's Citation for Production Ideas highest honor bestowed by WPB's Board of Individual Awards for his development of a new channel tread tire

Robert H Wendt chief engineer and **Kenneth W Tibbits,** production manager both of Taylorcraft have been named vice-presidents

C H "Cal" Calhoun is named supt. of maintenance for Mid-Continent Airlines

H Danforth Starr is appointed asst. to the president of Northeast Airlines and will supervise all forms of postwar planning

George T Bulladge is supervisor of planning for American Airlines **Gordan S Lundgaran** is appointed asst. to the advertising manager and in charge of production **Joseph E Terry,** former traffic supervisor becomes field asst to general traffic manager **John H. Bartel** is appointed asst to the New England traffic manager

F C Kreeger, v-p of General Motors is on leave of absence because of illness **E B Newill** is named general manager of the Allison division in his place

H H Friend leaves Scintilla Magneto to become development engineer at Electronics, Airplane division department of the newly formed development division of Curtiss Wright

Cornelia M De Jong, passenger traffic manager of The Holland-American Line was honored at a dinner on completion of 40 yr of service with the company. He is now also in charge of space reservations on the newly established KLM service between Miami Netherlands West Indies and South America.

Harry Agerter, formerly with CAA and later sales manager, Aircraft Division Engineering & Research Corp. has been named general manager of Aircraft Components Inc

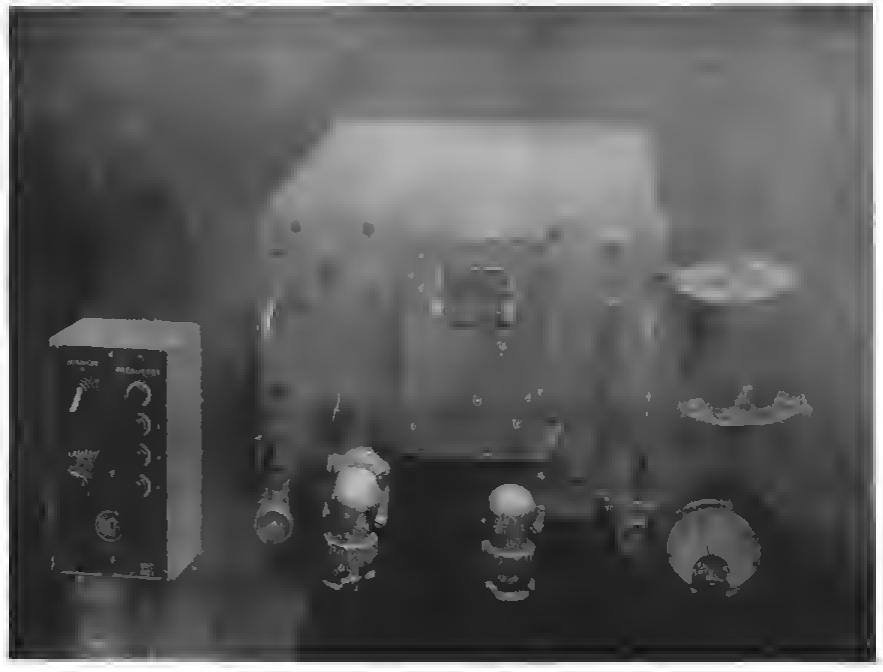
Obituary

Richard C du Pont, 32, special assistant to the commanding general of the AAF glider program, authority on engineless flight, holder of a 158-mi soaring record made in 1934 and much credited for the Army's decision to develop glider tactics (page 268 Sept. (AVIATION)). He had been a glider manufacturer and developer of the airmail pickup system through All American Aviation, the presidency of which he resigned to serve in the Army (page 307 June AVIATION)

George E Irvin, 49 authority on aircraft instruments and in charge of rebuilding them for military craft at Consolidated Vultees San Diego plant. He conducted courses there and in Tulsa and was the author of widely-used textbook *Aircraft Instruments*

G Willis Tyson, Jr, 38, general manager of Embry-Riddle Co's Riddle field and previously in charge of training RAF cadets at the organization's Carlstrom Field. In 18 years' flying he had been a commercial pilot and CAA inspector and test pilot

Maj Edward G. Schultz, former governor of a National Aviation Training Assn region and flight director of the Maryville School of Aeronautics





READY FOR THE "GREEN HELL"

HEAT-LADEN moisture is a deadly enemy of electrical installations—and aircraft radio equipment is no exception.

Yet the radio apparatus of America's fighting planes and bombers *must* function perfectly in landing fields and dispersal areas hacked from the "green hell" of Pacific jungles.

The ability of RCA aircraft radio units to meet these conditions is proved by test—and confirmed in service.

The picture above shows such a test—an RCA laboratory "sweat-room" in which RCA aviation radio equipment is exposed to steam-saturated atmosphere at 60° C. (140° F.) and 95% humidity.

There the equipment is prepared for the ordeal of rain-drenched Guadalcanal or New Guinea.

Such procedures are typical of RCA radio engineering and manufacturing. At every step theory is supplemented by severe and exhaustive tests to make sure that *stamina* accompanies efficiency.

These characteristics, essential to war planes, will be equally valued for postwar transports. Then, as now, efficiency and stamina will be "built-in" qualities of RCA Aviation Radio.



RCA

RCA AVIATION RADIO

RCA VICTOR DIVISION · RADIO CORPORATION OF AMERICA · CAMDEN, N. J.

Aviation Manufacturing

WPB Sweats Over Termination Machinery; Only New Law Will Satisfy Some Manufacturers

Washington (AVIATION Bureau)—Conceivable early cessation of hostilities in Europe and continuous war order cutbacks give rise to increasing concern over termination of contracts. WPB's Procurement Policy Division is trying to formulate a uniform termination clause. It would become a rider on all existing contracts. In the attempt to reach a satisfactory solution more than two score drafts have been made.

The War and Navy Departments, Maritime Commission, and other procurement agencies have already terminated thousands of contracts for munitions and supplies—in fact more in terms of dollars than were canceled at the end of the last war. But most of these terminated deals have not been finally settled, and the manufacturers want to get back their investments and get going on something else. Interminable litigation followed World War I and will also follow this war unless better liquidation machinery is devised.

WPB wants additional legislation, so does the War Department and the aviation and most other industries. At this writing the Navy Department and the Maritime Commission had not asked Congress to take action, but it was assumed they would. Most seriously in need of relief are small concerns. Subcontractors and sub-subs must deal through prime contractors that takes longer and they are less able to wait.

Army and Navy and other agencies have authority to cancel contracts and refund money at their own discretion. But the manufacturers want Congress to say that they *must* pay off—immediately—and negotiate differences later.

Sen. James Murray has introduced a bill providing mandatory advancements to contractors and subcontractors of not less than 75 percent of the canceled portion of contract payment to be made within 30 days from time of certification. It also provides for additional loans.

Rep. Andrew J. May's bill introduced at the request of the War Department gives the Secretary of War a blank check to pay off contractors as he sees fit. Naturally this bill is not supported by many contractors.

Some leading members of the aircraft industry want legislation providing mandatory advance payments up to 60 percent of the cancellation, authority for contractor to settle with subs up to $25,000, and subcontract claims in excess of $25 000 to be turned over to the government for advances up to 60 percent. They also advocate reimbursement of termination expenses, such as unexpired leases, severance compensation for employees, that the procurement agency having predominant business in a plant settle for the other agencies, and right of appeal to the courts from decisions of department heads. There is no provision in present regulations or laws for termination costs only for direct cancellation reimbursements.

While these manufacturers did suggest changes in present regulations they stated that only new legislation would be satisfactory to them.

Convair to Produce "Seawolf" Torpedo Plane

Okay of the *Seawolf* a new Vought-designed eight-ton torpedo plane for the Navy has been revealed by Rear Adm. Ralph E. Davison of the Bureau of Aeronautics.

Speaking at the dedication of a new airport adjoining the Allentown, Pa., plant where the plane will be made by Consolidated Vultee, Adm. Davison said the plane designated TBY-1 carries a gunner and radioman-bombardier in addition to the pilot and incorporates everything we have learned about planes of this type. It is powerfully armed and well armored. There is no other torpedo plane in the world to match it."

Navy's present standard torpedo plane the Grumman *Avenger*, weighs six tons and carries a crew of three at top speed of about 270 mph. Span is 53 ft. and length 37 and range probably better than 1 200 mi.

Protests Unlikely to Affect Renegotiation, Recapture

Washington (AVIATION Bureau)—Complaint from war contractors about the renegotiation law is almost constantly being dinned into the ears of congressmen. Manufacturers believe they should be allowed to accumulate reserves to rehabilitate themselves after the war.

House Ways and Means Committee has several bills up for consideration. One of them would raise the minimum volume of business per year on which a manufacturer is subject to renegotiation from $100 000 to $500 000. Another would provide numerous relaxations in the existing law. Still a third would repeal the law altogether.

The government repeatedly contends that the renegotiation law is intended only to prohibit excess war profits and that it is not concerned with taxes. Nevertheless, some members of the aircraft and other industries are urging that renegotiation be based on net profits after taxes.

Navy has advised the House Naval Affairs Committee that it believes existing tax laws are not too severe and that in many cases the 10 percent postwar credit allowed under excess profits law would be very substantial.

Army and industry witnesses are being heard but majority opinion is that there will be very little relaxation of profit recaptures.

New Northrop Announced

A new and deadlier type Northrop-designed airplane with many new tactical features is being delivered to the Army on schedule from assembly facilities converted during the summer from production of A-31 dive bombers, it is revealed by LaMotte T. Cohu, general manager of Northrop. Mr. Cohu also revealed that in the company's fiscal year ending July 31 "our deliveries amounted to approximately $70 000,000, an increase of more than 100 percent over the previous year's $33 000 000."

General Aircraft Reports Tally of Workers' Opinions

According to a poll of employees conducted by General Aircraft, Astoria, New York City, 68 percent of the workers engaged in the manufacture of CG-4A gliders think the top management of the company is competent, that shortage of materials is the greatest production bottleneck (62 percent vote, absenteeism ran second with 20 percent), that stories of gliders in action will build morale better than speeches by company or government officials (42 percent vote against 27 percent), that their fellow employees are competent (82 percent), that their foremen know their business (74 percent) and do not play favorites (60 percent) and that they had been given jobs for which they were fitted (78 percent).

Task for the keep-the-plant-busy-department: Only eight percent expected to be laid off or return to former businesses when the war ends.





NEW PRODUCTION COUNCIL PRESIDENTS

Lawrence D. Bell (left), president of Bell Aircraft has begun serving a four months' term as president of the Aircraft War Production Council, East Coast as well as of the National Council, succeeding J. Carlton Ward of Fairchild. Other new eastern officers are L. C. Goad, general manager of General Motors' Eastern Aircraft, vice president; Ken Ellington, secretary and Francis T. Boyd, assistant treasurer. New West Coast Council president is T. Claude Ryan (right), president of Ryan Aeronautical Co. who succeeds LaMotte T. Cohu. Western vice-president is Courtlandt S. Gross, president of Vega.

Lockland Engine Production Recovering; Trial in Federal Suit May Be Postponed

Wright Aeronautical Corp's Lockland (Ohio) engine plant is making a remarkable recovery from its recent production decline—a decline partially attributed to effects of the Truman Committee's charges of poor management and inspection.

Executives say that August production will be much higher than anticipated and that the September output will be double that of August. It is privately stated on good authority that the company expects to catch up with its previously projected rising production curve about the first of the year.

William D. Kennedy, who heads the new Lockland management, is credited with decisive measures which have contributed largely to improved performance. Other important factors are renewed confidence of the Army and Navy in the management and better spirit among the workers. Labor leaders of CIO United Automobile workers organizing the plant have laid blame for the recent production slump to the tactics of the Truman Committee in the material and timing of its report.

A defense is being prepared in response to the suit filed by the Department of Justice upon recommendation of the Truman Committee. Some observers believe trial will be postponed because the waste of executive time in the midst of war might meet with public disapproval.

In view of Truman charges that C-W had got more than its share of war contracts, it is interesting to note that RFC has approved an additional $5,500 000 for equipment in Wright Aeronautical plants in Paterson, N. J., bringing the total commitment to $45,000 000.



ICER—INSTEAD OF DE ICER

Water from tanks in bomb bay is sprayed through outrigged pipe onto propellar blade of 'Liberator' used at Wright Field for studying ice formations at high altitude. AAF Materiel Command engineers have also installed a camera, synchronized with propellar speed, which makes detailed views through window in fuselage.

Reports on Production And Company Notes

Production of Grumman *Wildcats* and *Avengers* nearly 1 000 percent greater in the last six months than during the equal previous period is reported by Eastern Aircraft. Eastern also released the text of message from Rear Adm. Ralph E. Davison, of the Bureau of Aeronautics, congratulating workers and management on the delivery of 'many hundreds' of both models during the first year of production by the General Motors subsidiary.

Landing gears for Grumman *Wildcats* are now being mass-produced ready for tires by Willys-Overland Motors in Toledo.

Congratulations from WPB, the Army, and Pres. Harry Woodhead have been received by Consolidated Vultee's Fort Worth plant for exceeding schedules for the second successive month.

Buick production of 1 200 hp engines for *Liberators* is at an all-time high, according to that company.

In Wichita, Kan., Boeing estimated that it "ranks at the top of the list of 42-plane-making facilities of the nation for the number of completed units and spare parts per employee delivered to the armed forces."

Paul W. Litchfield, president of Goodyear Tire & Rubber, says the company intends to continue in the aircraft business after the war. Goodyear Aircraft is now building Vought-designed *Corsairs*, under the designation FG-1 also other parts and subassemblies.

Resumption of production of entire planes, after a two-year hiatus, is announced by Bellanca Aircraft Corp., Newcastle, Del. The company is making Fairchild-designed AT-21 two-engine trainers, which are also being built by McDonnell Aircraft Corp., of St. Louis.

Asbestos fabric output is being increased 50 percent by U. S. Rubber Co.

Formal entry into aircraft manufacturing by machine tool builders (page 272 Sept. AVIATION) has begun. Lodge & Shipley, Cincinnati, have signed contracts with General Motors' Aero Products Corp. for production of propeller parts.

Pacific Car & Foundry in Seattle has shifted from tanks to production for Boeing.

A $500 000 addition has been made to the Williamsport, Pa., plant of the Aviation Corp.'s Lycoming Div.

August Production Was 7,612

August plane production gained in numbers but was still behind schedule.

WPB announced that the 7,612 planes produced represented a gain of 3 percent. Heavy bombers were up 11 percent and fighters 5 percent. "Our production rate," said WPB, "now has grown to a point where interruptions for design changes can be made without seriously threatening the flow of planes to the fighting fronts."

Charles E. Wilson vice-chairman of WPB, has been devoting a major portion of his time to driving production up to 10 000 monthly by the year-end despite serious manpower difficulties.

Many highly-placed observers point out that the aircraft industry has just about equaled total production of all the rest of the world and that that is good enough. But Army and Navy air force commanders still call for more and more.

Frederick Crawford, head of Thompson Products, Cleveland makers of airplane parts says production must be stepped up 45 percent to meet the schedules laid down. Donald W. Douglas president of Douglas Aircraft, says that "even with the most miraculous improvement in utilization of present working forces we could not begin to approach the production needed to meet the schedules." He argues that the industry must get more manpower from somewhere.

Rough Air "Easers" In New All-Wing Plane

A new all-wing airplane with "sprung" outer wing panels to give a kind of knee action for easy riding in rough air has been designed by George Cornelius, president of Cornelius Aircraft Corp. Dayton, Ohio and flown at Vandalia, Dayton municipal airport. The Army, aware of the flight, was interested, but to what extent is not known.

The 20-min. test at about 100 mph was made by Al Reitherman, assistant to the president of Spartan Aircraft Corp., Tulsa. Reitherman said he had flown about 100 types of airplanes, and that this one was most interesting. The test model has a 30-ft. wing-span and 230 sq. ft. of wing area. It is 17 ft. long and weighs about 2 400 lbs. It is powered with a Franklin 130 hp engine, but Cornelius said it was intended to carry 185 hp. and was thus underpowered.

The outer wing panels are moveable vertically in a limited arc to absorb shock. The mechanism of this feature was not described in detail. The vertical fin is extremely high to give positive control. The plane can also be built with fixed wings. Counter-ballast is carried forward to offset the light engine.

★ FOR THE RECORD ★

Cooper Alloy Foundry Co., Hillside, N. J., has completed new plant for manufacture of centrifugally-cast alloy castings.

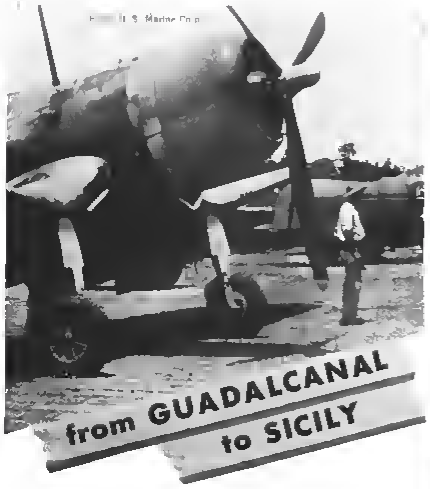
Clarostat Mfg. Co. has moved its general offices to 130 Clinton St., Brooklyn.

J. Earl Simonds, plastics consultant, has opened new office at 122 East 42nd St., New York 17.

American Smelting & Refining Co., 120 Broadway, N. Y., has organized new department under H. Herrmann to manufacture lead counterbalance weights for ailerons, elevators and rudders.

NE Steel Use Urged

Recommendation that National Emergency Steels be used wherever possible is contained in Conservation Directive No. 3A prepared by the Operating Committee on Aircraft Materials Conservation and approved by Army, Navy, and WPB.



Aircraft parts of AMPCO METAL assure safer, more reliable flight

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P R MALLORY & CO

Two Stars

HANDY & HARMAN

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B F GOODRICH CO (Niagara Falls Louisville)
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Army-Navy "E"

AERONCA AIRCRAFT CORP
BENDIX AIRCRAFT CORP (Owosso Mich.)
BRISTOL CO
CHICAGO WHEEL & MFG CO
DOUGLAS AIRCRAFT (Long Beach)
GENERAL MOTORS CORP (Aero Products Div.)
B F GOODRICH CO (Akron Watertown Mass., Texarkana, Tex., Clarksville, Tenn. and Los Angeles)
LINK-BELT CO. (Chicago)
MICRO SWITCH CORP
NASH-KELVINATOR CORP

A second "E" award was refused by Irving Subway Grating Co., Long Island City, N. Y., manufacturer of airfield landing mats. Irving alleged that its contract was cancelled while normal production was continued by Carnegie-Illinois Steel Corp. The company said the War Department, "was not obligated to return the E flag due to the fact that it no longer had war business."

Engine Contract Signed With Brazil by Fairchild

Ranger six-cylinder in-line aircooled engines from 175 to 200 hp will be manufactured in Brazil by the government's plant, Fabrica Nacional de Motores, under a contract signed with Brazil by Ranger Engine Div. of Fairchild Engine and Airplane Corp.

Fairchild will supply complete manufacturing data and drawings of tools and assemblies, instruct Brazilians in its Long Island factories, and ship semi-knocked down engines for training of native labor. Engines will be used in Brazilian Muniz M9 biplanes in two-engine Grumman *Widgeons* now in official government service, and in the Fairchild M-62's (AAF PT-18) which are being built at the Galeao Aircraft Factory, Rio



ON THE NOSE TO WIN

Above: Liberators coming from Consolidated Vultee's Fort Worth plant and from Ford's Willow Run lines now feature two 50 cal. nose guns swung by an Emerson electric turret. Power is now also being used in ball turret as well as in tail and top. Total number of "Liberator" .50's is 13. Below: An equal number of guns is mounted in "Flying Fortresses" with new nose installation of two pivoting .50's



Domestic Applications Still Pour In to CAB, But Availability of Equipment Is Unpredictable

Washington (AVIATION Bureau)—If all the applications and paper plans for setting up additional air services in this country are realized the airline map will finally look like a fish net.

Most impressive recent program is that of Penn-Central, which proposes a "coordinated" system in 23 states, giving "direct" service between numerous big cities in the industrialized eastern half of the country, and establishing 'direct mainline' service to nearly 100 other cities. Company's statement says the new routes are a direct outgrowth of its pioneering in the 'short haul' field. Penn-Central recently applied for extension into New York and New England, entering 4 new states and 22 important cities.

CAB is still receiving applications from truck and bus companies to operate helicopter services. Four new applications cover seven midwestern states, three eastern states, and points in New England. One is from the Yellow Cab Co., which wants to operate a helicopter cab service within a 60-mi radius of Cleveland. Helicopter applications totaled 32 at this writing. In most cases the applicants desire to transport mail, passengers, and baggage, supplementing local ground services and connecting with main airlines.

Prospects for additional airliners to carry bulging traffic on the scheduled airlines were still vague at this writing. The Post Office Department has been put in an embarrassing position by delays and carriage of mail by train for lack of airplane space and is using its strong influence to get more Army DC-3's turned back to the lines. Out of about 150 taken by Army, only eight had been returned at press time. It was hoped that as many as 24 might be given back during the year and that in 1944 deliveries authorized to the transport system, including new and larger craft, would bring the carriers' capacity above prewar level.

But the domestic equipment situation is unpredictable. The Allied drive for bases in China and cargo plane requirements in recaptured European territories might still be greater than our production for some time. On the other hand, if the output of combat planes should catch up with Allied capacity to use them, we could turn to additional cargo production.

The Post Office is hoping that the airlines can obtain enough equipment so that airmail priorities can be avoided.

Among applications recently filed with CAB are:

Braniff—extension from Chicago to Detroit.

Mid-Continent—Kansas City to St. Louis; St. Louis to Detroit; Kansas City to Atlanta; Minneapolis-St. Paul to Chicago and to St. Louis; Tulsa to New Orleans and to Dallas; Minot, N. D. to Regina, Saskatchewan; feeder routes to 136 localities near present routes; and intermediate stops on present Kansas City-Tulsa run.

New Haven Railroad—Southern New England line integrated with rail service.

Vermont Transit Lines—Helicopter service in ten local northern New England routes.

TWA—Addition of 95 cities to 28 already served "by creating an orderly series of new routes which would largely parallel existing trunk lines."

United—Chicago to Detroit and Newark-New York.

Lynchburg Air Transport and Sales Corp. is asking permission of Virginia State Corporation to own and operate an airport near Lynchburg, Va.

At a CAB New York hearing on routes to Boston, Capt. E. V. Rickenbacker, president of Eastern Air Lines, asserted that his company "is willing to declare a moratorium on earnings or dividends for a period of three years after the war is over by investing not only our present cash reserve but all the millions we can borrow in a sound and sane expansion program."

New York-Boston applications have been filed by Northeast, TWA, Colonial, Seaboard Airways, Eastern, and United with New England Airlines as intervener. American now operates the only service.

Express in 17th Year, Airlines Revenues Up

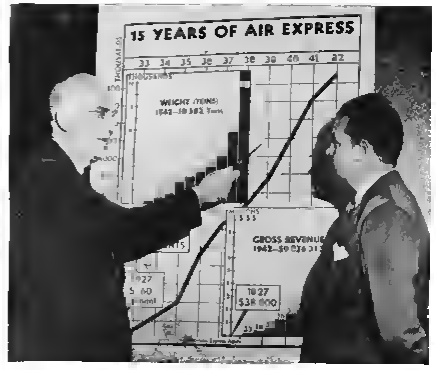
In 1327 transcontinental air express took 36 hr. and 16 fuel stops in single-engine planes, and a 25-lb. package cost $65. Last month as Railway Express Agency celebrated its 18th anniversary of contract air service begun on a route now operated by United, the same package could be sent for $21.

War traffic had hoisted air express volume to 2,558,000 lb. in April this year, 68 percent more than for April last year. International traffic in the Western hemisphere increased 5,862 shipments during the first half of this year over 87,420 shipments in the same period last year.

All sorts of schemes are being studied for speeding up the ground part of the service. In accordance with rulings of CAB, the airlines are free to organize their own ground service or make contracts with other surface carriers. So far, no better than REA service has been seen, and some operators predict it will be five or six years before the airways can afford a pick-and-deliver system of their own. The express company, as the law now stands, is not eligible to apply for a certificate to operate aircraft.

CAB Line Figures

Official operating figures of 17 domestic lines released by CAB for June show these increases over the same month last year: Express lb-mi 37.9 percent; mail lb-mi 77.8 percent; revenue miles 14 percent; revenue passenger-miles 32.8 percent. Lines completed 89 percent of their scheduled mileage during the month, and the average load was "nearly 16 passengers, 654 lb. of mail, 312 lb. of express."



Steadily ascending volume of air express—10,582 tons in 1942 resulting in gross revenue of $9,036,383—is pointed out by K. N. Merrill (left), Railway Express executive. Shipments between U. S. and Latin America, for which REA is receiving and delivery agent, numbered 87,420 in first half of this year between 200 cities in Mexico, Central, and South America and 350 airports in this country.

"For the year ending May 31,1943," CAB said, "the net operating revenue for all domestic airlines was $31,020,000 as compared with $13,377,100 for the year ending May 31, 1942, an increase of 131 percent although the lines received $834,400 less mail revenue. Express and freight revenues showed the greatest increase from $3,992,500 to $8,357,800."

Expansion Commenced At Commonwealth Airport

Boston (Special to AVIATION)—Massachusetts has completed plans to establish this city among the leading postwar airborne passenger and freight centers.

Chairman Powell M. Cabot of the State Development and Industrial Commission has announced final plans for major improvements and extensions of runways at the Commonwealth Airport, East Boston. The blueprint provides for ultimate construction of dual 10,000-, 8,000-, and 7,000-ft. hard-surfaced runways, each 200-ft. wide, with space for taxi strips and helicopters as well as a hydroplane base. Some of the work has already been started. The airport, which now covers 270 acres, will be expanded to approximately 1,200 acres.

Eastern, which has an application pending for a New York to Boston extension, has reopened offices in The Hub business section.

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ALL "Aero-Seal" Hose Clamps feature this wide clamping range. The band is perforated for a long take-up, permitting the clamp to be used on several hose sizes. Also featured is the belt-like tightening action which produces uniform clamping pressure around the entire periphery. These points make "Aero-Seal" Hose Clamps specially good for self-sealing hose. Write for full information.

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Federal Aid for Airports and Training Advocated at Midwest Air Conference

Because the war has outrun and submerged the 1938 airport program, Charles I. Stanton, Civil Aeronautics Administrator, proposed a new one patterned on the federal-aid highway program in a speech before the recent Midwest Global Air Conference in St Paul.

If the plan were adopted, appropriations would be allocated among the states on a four-factor formula: Area of the state, its population, number of its registered aircraft, and existing number of accredited airports. Federal control would be decentralized and the program would be mostly in the hands of state agencies. Only sites included in the CAA airport plan would be eligible for federal aid, and CAA standards would have to be met.

Stanton argued that the government's share in the program would prevent state regulations from hamstringing progress while local problems would be decided by local people.

Charles B. Donaldson, director of airports for CAA, told the conference that the 1938 program called for 4,000 ports of various classes. Because of the war there are only 3,000 in operation. But while the 1938 plan called for only 48 Class 4 ports (4,500-ft. runways and up) we are constructing 250 and by the war's end will have 600, including many built by Army and Navy. We planned 1,800 Class 4 fields (the number in operation is apparently not known). We have 600 Class 2 fields and 416 Class 3.

CAA training director R. McLean Stewart advocated instruction for 100,000 young men a year to replace veterans whose age may put them out of the picture a few years after the war is over. He recommended government financial assistance for a program to make all possible use of civil facilities.

The conference, attended by more than 500 experts and representatives of communities in eight northwestern states, was arranged by the Twin Cities Chapter of the National Aeronautic Assn. and opened with exercises dedicating the new University of Minnesota airport financed by a $124,000 grant from the university and built on a 260-acre tract contributed by it. Twin Cities Chapter also took occasion to announce that as a result of its efforts during the past year the Minnesota legislature had enacted an aviation program embodying use of state money for development of airports.

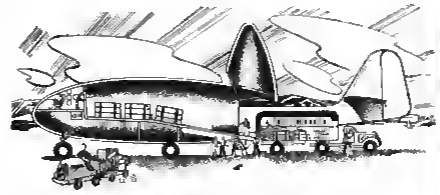
An analysis of the present business volume and future prospects of Canadian aviation was given the conference by C. H. Dickins, vice-president and general manager of Canadian Pacific Air Lines, who urged more connecting services with the U. S. and expansion of routes in Northern Canada. 'In the air age ahead,' Mr. Dickins advocates a Canadian outlook "not just for one route or one service but for as many routes and services as may be required to meet and maintain Canada's position as a top-ranking world trading nation."



Civil Aeronautics Administrator Stanton (right), principal speaker at Midwest Global Air Conference, dines with Pres. Lowell H. Swenson (center), president of NAA Twin Cities Chapter, and H. J. Berg, Jr.

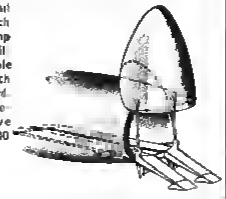
Big Traffic Zoom Predicted by Wolfe

Air transport will not bankrupt railroads and ship lines after the war, but traffic will multiply 40 times during the first decade of peace. Thomas Wolfe, vice-president of Western Air Lines, predicted in a speech on "Postwar Commercial Aviation" before the recent meeting of the Society of Automotive Engineers in San Francisco. But he predicted that airlines will carry 20 percent of the number of first class rail passengers, 10 percent of the number of second class rail and first class bus passengers.



MARTIN CARGO CRAFT DESIGN

New cargo plane design patented by William D. van Zelm of Martin engineering dept. and assigned to company accommodates load in fuselage extending all from wing between twin tail booms. Hydraulic mechanism which raises cargo door also extends ramp adjustable to ground or truck tail board level and supported by adjustable jacks at hinge point (inset). Winch at front of fuselage draws cargo aboard. Designs have been drafted for two- and four-engine models with respective gross weights of 60,000 and 86,000 lb. (page 273 Sept. Aviation).



Warplanes Not Suited For Peace, Crary Says

Los Angeles (Special to AVIATION) — Major U. S. airlines are unlikely to willingly accept wartime transport airplanes for conversion to competitive commercial operation as now being proposed, in the opinion of Harold Crary, United Air Lines vice-president in charge of traffic. Newer, more efficient models better suited to postwar needs can be built in sufficient volume and at costs in line with those of conversions, Crary told reporters at a conference following a recent speech before the Los Angeles Advertising club.

In his speech, he predicted radical trade practice changes by the air transport industry following the war. He envisioned transport planes much larger than the 100-passenger ones commonly predicted and expects them to have cruising ranges of 2,500 mi. at a speed of 260 mph. Supplementing these large planes will be smaller, 75-seat craft with a range of 1,200 mi., as well as various other still smaller types for feeder and intermediate service and special cargo planes. He predicted 12-hr. trans-Atlantic service at a fare as low as $150.

He does not believe that airplanes will seriously affect rail, steamship or truck and bus transportation but will supplement them. All forms of transportation will be greatly improved and coordinated, he said.

★ CROSS COURTRY ★

Relaxed daylight blackout rules aboard planes are working satisfactorily. They now call for shades drawn 3 min. before landing and after takeoff at Dallas, Tulsa, Colorado Springs, San Francisco, and Oakland and 5 min. at New York and San Diego as well as at airports adjoining factories and modification centers.

United has opened new offices in the Hilton Hotel, Long Beach, Calif., and installed a pneumatic cashier system in its Los Angeles office. American has also absorbed insurance premiums in Mexican flights into price of ticket.

Study of aviation laws of other states, hearings on needs for facilities and conferences with federal authorities on financing problems are among objectives of new North Carolina Aeronautics Commission which reports that 100 airports and landing strips are maintained in the state by the military, municipalities, and individuals.

Cargo loading equipment devised by Col. E. S. Evans of Detroit is reported in use on Army and Navy transport planes. Ingenious ropes and irons can be used repeatedly to tie down various shaped boxes and barrels. Substitution of cardboard for wooden crates is reported by PAA to have saved 27,455 lb. in one month of overseas shipping.

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Standard screws for all assembly operations where lock wire is required. MANY STOCK SIZES NOW AVAILABLE FOR IMMEDIATE DELIVERY. Sizes range from 4-48 x 3/16 to 7/16-18 x 3 in low carbon steel, and from 6-40 x 1/8 to 5/16-18 x 2 in heat-treated nickel steel. Made to specifications AC500A, AC501A, AN502, and AC503. Highest quality material and workmanship. Threads are clean and sharp, heads upset and turned to size, slots and holes well burred, plating bright and uniform.

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to KEEP 'EM ROLLING!

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Now, with locomotive-miles per month boosted about 40% above the pre-Pearl Harbor figure, railroaders rely upon the enhanced mechanical properties Nickel adds to iron, steel and non-ferrous alloys.

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New Catalog Index

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Airlines File for More Foreign Routes While Goverement Debates Service Policy

Washington (Aviation Bureau)—When the 18 airlines declared in favor of a free-for-all policy on foreign routes they apparently meant business, for they are pitching their applications in.

TWA has filed to link New York, Boston, Chicago, and Detroit with London and Paris. American also asks for a certificate to operate between New York, Boston, and London. Northwest has at last filed its plan for a run from Seattle or Anchorage, Alaska, to the Philippines and Calcutta India, and TWA recently announced intention to file for an extension to Honolulu. Braniff has asked for routes from Dallas, Atlanta, and Charleston to Bermuda and the Azores, Lisbon and Spanish cities north to Paris, London, and Berlin to Oslo and south to Rome, also from Houston to the Caribbean and Central America to Buenos Aires.

To visualize what international transport may do to fares by 1948, Pan American posted a list of estimated schedules in New York's Museum of Modern Art Samples: Bermuda 2 hr. 40 min. flight time, $37.26 round trip, Paris, 15 hr., $202.50 round trip.

Proposed overseas services will require foreign approval as well as that of CAB and, so long as the war lasts, that of the Army and Navy also. In most cases it would be necessary for new services to obtain additional equipment, Army and Navy would be more likely to approve delivery of planes for certain foreign routes important to the war effort than they would for domestic operation. United Air Lines recently received a C-54A, military transport version of the Douglas DC-4 transport.

It has not been stated officially whether the Administration will approve certification of overseas lines until after a foreign air transport policy has been formulated and approved by the government. Both Congress and the Administration are now deeply involved in this problem, and it cannot be settled until mid-winter at the earliest.

CAB is making a study of international air transport routes and has invited 'interested' persons to submit suggestions as to which ones should be operated after the war. The study does not take into consideration the identity of carriers by which such services should be operated. The board simply means to determine which routes would be desirable. (Those who expressed their views in reply to a previous questionnaire need not repeat them.)

United Air Lines, which did not join in the resolution favoring free foreign competition believing that such a policy would result in starvation revenues for most or all participants, appears to favor a single foreign system owned jointly by the several established transport companies. Presumably Pan American Airways would be the nucleus of such a system.

The matter of a single or multiple service will be fought out in the Administration and in Congress. Controversy over this question has already spread to England, which has always had a single foreign-service company.

Instrument Landings To Aid Air Forces

The instrument landing system, initiated at CAA's Indianapolis station and further developed at ten major airports, is now being expanded, with installations underway at 100 fields important to the Army.

The system consists of ground equipment which transmits a glide path and localizer and vertical marker beams. Receivers for planes are being produced in large numbers but assigned to military use only. They were on order at the time the war began.

A cut in the losses of planes in bad-weather landings back at their home bases after raids on Europe is looked for through use of the system, also foreseen is further general employment of craft in poor weather. Authorities believe that eventually instrument-landing installations will permit a near perfect record of commercial schedule completions.

Government May Push Uniform Carrier Liability

Washington (Aviation Bureau)—Webb Shadle, general counsel for the Civil Aeronautics Administration, predicts that the federal government will assume jurisdiction over all United States air space and establish uniform liability for air carriers.

He says that if all the states adopted a uniform body of law, even bad law, the uniformity itself would remove conflicts. But such adaptation, he feels, is too much to expect. If insurance companies do not provide satisfactory coverage, he states, there might be self-insurance by the airlines, government subsidy, or regulation of insurance companies. In his opinion, establishment of uniform liability would make it necessary for the government to enter the aviation insurance business.

Mr. Shadle's statement appears to be a reiteration of expressions by members of the industry, months ago, that the government would be invited to underwrite an insurance and re-insurance program unless the insurance companies got together and provided adequate service. It was charged that re-insurance is largely controlled by British interests.

CAB Revises Rules, Hands Down Decisions

Revisions to Sections 238.1 and 225.4 of Economic Regulations announced by CAB provide that: (1) "Service of notice by applicants for Certificates of Public Convenience and Necessity is no longer required." Notices of filings will be posted, issued to the press, and reported weekly to carriers and applicants by the Docket Section, (2) Domestic and foreign applications are to be filed separately, (3) 'Maps attached to applications no longer are required to include existing services by other carriers to points involved in the application"; (4) "Any person, including any state, political subdivision thereof, state aviation commission or other public body may appear at any hearing and present any evidence which is relevant to the issues."

In other actions CAB has (1) permitted All American Aviation to serve Ripley, W. Va., on certification of the Post Office that daily mail service was required, (2) dismissed application of Boston & Maine and Maine Central railroads for approval of control of Northeast Airlines, (3) granted Western a certificate to operate between Los Angeles and San Francisco.

Ticket Amputated

United Air Lines has abolished the traditional five-foot ticket. Now United simply writes point of departure and destination on a card, any stopovers are punched out. Iconoclast responsible is Auditor George Fleming.



United's new Douglas "Skymaster" cargo carrier, designated C-54A, is being used in over water service with the Air Transport Command. It has four 1,350 hp engines, capacity of 14,000 lb. and average cruising speed of better than 200 mph.

Aviation Abroad

Russia Releases Dete Oe LAGG-3 Wooden Craft

Full details were recently released on the Russian LAGG-3 pursuit, which is constructed out of plastic bonded plywood. With a 33 ft. 3½ in span and a length of 28 ft. 5 in. the plane weighs 5,770 lb empty or 7 000 lb fully loaded.

With a 1 350 hp. engine, the plane has a top speed of 348 mph at 16,500 ft., with a 30,000 ft ceiling and a 400-mi range. The plane is said to land at 87 mph., extremely low for a high speed pursuit, equipped with 20 mm cannon and heavy armor.

Interesting construction features are the low pressure hydraulic system operating the landing gear and flaps also the exhaust gas converter. The latter changes exhaust gases to inert gas which is piped into the gas tanks to eliminate explosive fumes.

Lag in British Labor

Report by Britain's Select Committee on National Expenditures indicates that England, too, is "head put to it" for labor in the aircraft field. A high figure of 33 percent in labor turnover is pointed to by the committee which notes an acute shortage of technicians, foreman and qualified staffs in all grades of management. The committee urges that men of technical training not be absorbed by the fighting services. Spare parts particularly are said to have lagged.

Panagra Marks 15th Year

Panagra (Pan American-Grace Airways) recently celebrated its 15th anniversary of South American scheduled transport service. Currently, the Panagra route mileage totals 8,800 mi., serving the Canal Zone, Colombia, Ecuador, Peru, Bolivia, Brazil, Chile, and Argentina. Pres. Harold J. Roig points out that his line was one of the first to contract for DC-4's and continues that "we anticipate using four-engine planes in postwar work." Also reported by the line is provision for extensive new radio installations.

★INTERNATIONAL BRIEFS★

A military version of the Italian Piaggio four engine transport has been announced. Obviously modeled after the original Boeing 299, the plane has four PXIIRC35 radials of 1,350 hp. giving it a top speed of 299 mph. Only unusual feature is the pressure cabin in the bomber version.

"Secret weapon" promised for months by Germany is reported to be a robot plane, a model of which recently landed in Sweden. Robot planes are nothing new, being used generally for target practice. And radio control can be scrambled, or the controlling plane shot down, dooming the robot planes under its direction.

A general scramble for South American lines is expected soon following an announcement by the CAB that it will consider applications for lines from America to Mexico, the Caribbean area, and South America. Many of the large carriers are expected to file applications.

Reports from France, via the underground, state that it has been impossible to obtain any real production of German model aircraft from French factories. The plane shortage in the Nazi training schools is so serious, however, that outmoded French planes like the Dewoitine applied and Leo et Olivier craft are being pinced in production again.

The Nazis have recently been flying captured Boeing *Flying Fortresses* alongside American formations raiding Germany—to foul-up attacks. While it is possible for Germans to reconstruct one or two good B-17's out of every 30 or 40 shot down, the problems of spare parts and maintenance are such that they are expected to have little success with such tricks.

The United Nations are also flying captured planes—some South African Air Force squadrons based in Africa have a flying complement of just about everything the Germans and Italians have used, putting them to good use in training their own pilots. Some of the Axis transports are being used as flying ambulances, a suitable end to a nefarious behavior.

First passenger flight from the United Kingdom to Bathurst British West Africa was made in September by a *Liberator* of the RAF Transport Command. The 3,140-mi. non-stop hop was reported made in just under 16 hr.

Some reports now have it that Ernst Udet leading German Ace in World War I committed suicide when it became evident that he would be purged by Hitler — a story contrasting with the official one that he was killed in the crackup of an experimental plane. Udet was known to have had many democratic nation friends. He is said to have only acted as an adviser to the Luftwaffe.

Cunard, it is stated in London is now giving further attention to air transport a resolution being recently brought up looking toward acquisition of aerial conveyances by charter, construction, purchase, or hire.

At least half a dozen de Havilland *Mosquitoes* have been retired from combat duty and put in service with British Overseas Airways. With few modifications they have been used almost entirely for transport of specifically important mail and freight.



"YORK" SHATTERS MONTREAL BRITAIN RECORD

Fast time of 12 hr 26 min.—clipping 25 min. from previous best mark—was recently set by this Avro "York" (converted "Lancaster") over 3,000 mi. Montreal-Britain route. Pilot was Capt. R. F. George, TCA operations manager, and occasion was opening of line's new government sponsored trans-Atlantic mail schedule to serve Canadians overseas. Only Dominion line currently allowed to operate foreign service, TCA will get over-ocean experience invaluable in coming peace.

On Schedule . . . by "Vista"

With international developments piling up "on the double" during the past weeks any news now received about European airlines is unreliable at best. The following notes are offered however, for what they may be worth in rounding out the general picture.

Italian Ais Littoria discontinued all services under this specific name, feeling that this title smacked a little too much of Fascism and Mussolini. New name is Ala Roma. Another Italian company new and as yet unnamed announced that it hoped shortly to start services from Roma to Bucharest.

Rumanian Lares announced plans to operate a connecting service from Bucharest to Athens. However, it is now doubted whether either one of these Bucharest services can start under present conditions.

View of the possible future is offered by the Netherlands Indies government in an article release re discussions on postwar air transport. Expressed is an attitude which can be expected from some of the smaller United Nations, which have been dependent upon America for military supplies. In connection with reciprocity of landing facilities it is stated that the United States can hardly expect to be given such facilities by the Kingdom of the Netherlands if the United States does not do its utmost to assist the Netherland allies by provision of planes either by lend-lease, hued cash, or on some other basis.

If many more similar reactions are recoeded, there might again result a situation paralleling that of 1939, when most international routes were deadlocked on possible global expansion of air transport due to the refusals to recognize either world aeronautical viewpoints or complete reciprocity of all facilities.

In Spain, the government has bought out German interests controlling the Iberia airline, considered up till now to have been run as a blind for Nazi infiltration.

Aviation Finance

By RAYMOND L. HOADLEY

Liaas Financing for Postwar . . . More Manufacturers Get V-Loans . . . Little Hope for "Renag" Repeal

INITIAL steps toward financing postwar expansion are being taken by the airlines—money raising moves that may ultimately build up a grand total somewhere between $400,000,000 and $500 000,000. Already Braniff and Northeast are offering common stock for sale to the public while it is reported in investment banking circles that Penn-Central Northwest and Chicago and Southern are about to enter the capital markets. Relatively good conditions have prevailed in the securities markets for airline financing.

Meanwhile, aircraft manufacturers in growing numbers are negotiating revolution V-loans to assure adequate working capital to handle their ever-expanding production. Largest of these credits is the $200,000,000 loan arranged by Consolidated Vultee—second only, as far as is known, to the $1,000 000 000 credit taken out by General Motors. Consolidated Vultee is using only one-fifth of its loan, and other concerns in the industry also are not presently employing anything like all the money they have available at the banks. This would indicate that company officials had the switch-back to peacetime production in mind when they arranged the big credits. With aircraft volume still approaching its peak, it appears that this is the time to take out V-loans rather than when business is tapering off and prospects are more uncertain.

Now that Congress has returned from its short vacation it seems almost a certainty that the contract renegotiation law will not be repealed. True, Sen. George, the foremost tax authority in the Senate, favors such repeal, but he is not expected to win his point. Even so, increased allowances for postwar reserves the No. 1 problem of the aircraft industry, may be granted. Less likely is a revision providing for renegotiation *after* taxes instead of *before* taxes as at present. Renegotiation officials point with pride to the fact that over $4,000 000 000 has been returned to the government through renegotiation. What they neglect to point out, however, is that all but a hare fifth of this sum would be returned to the United States Treasury anyway in the form of taxes.

For the first time, excess profits taxes are showing up in a major way in earnings statements of the airlines. For example the American Airlines report for the first half of 1943 shows that 70 percent of net earnings for the period were set aside for federal tax reserves as compared with 45 percent in 1942. But despite this tax boost American joined other major airlines in reporting a sizeable gain in profits over the like 1942 period.

National Aviation Corp., an investment company specializing in aviation stocks, made a number of changes in its large portfolio of stocks during the first half of 1943. Additional Douglas common and some United preferred was purchased, but sales predominated in the six months' changes. Holdings were reduced in Bell, Curtiss-Wright, and Grumman. In addition blocks of several thousand shares of TWA, UAL, Braniff, Penn-Central, and PAA were closed out.

Curtiss-Wright, the nation's second largest war contractor, belatedly has issued its 1942 earnings report showing net profits of $13,143,515 or $1.45 a common share compared with $25,717,512 or $3.15 a share in 1941. Sales rose to $770 584,882 against $373,083,365 the previous year. Provision was made to return $175,139,379 to the government for voluntary price reductions and renegotiation while a postwar tax refund of slightly over $1 a common share was set up as a postwar reserve. Pres. Guy W. Vaughan pointed out that the report was delayed because of renegotiation proceedings. Net income last year was equal to only 1.3 percent on sales recorded by the company.

North American Aviation has issued a revised 1942 report showing that the final effect of renegotiation was to reduce net income from the previously reported $10 436,413, which was 4.3 percent of sales, to $7 370,626 or 2.91 percent of sales. In addition to voluntary price reductions of $17,500,000, renegotiation took another $18,200 000, of which $13 884,833 consisted of a credit for taxes and $4,305 188 will be refunded to the government.

Loans: Consolidated Vultee has arranged a $200,000,000 V-loan, of which only $40,000 000 is being used so far. Interest will be paid at a 3 percent rate on the funds used and 1½ percent on the unused portion. North American Aviation has floated a loan of $78,000 000 against which no borrowings have been made as yet. Aviation Corp. also established a $16,000,000 V-loan credit, with the parent company using $8 000 000 and two subsidiaries, American Propeller Corp. and American Central Mfg. Corp., using $4,000.000 each.

United Aircraft Corp. reports net income of $4,670,163, equal to $1.41 a common share, for the six months ended June 30, against a net of $3,478,408 or $1.16 in the like 1942 period. Sales were $333 783,454 against $242 708 316. The sum of $2,114,351 was added to postwar reserves. Bank loans issued in connection with government emergency plant contracts have been reduced by $27 513,129 and now stand at $10,281 878.

American Export Airlines has filed a statement with the SEC covering 43 888 shares of capital stock to be issued on exercise of capital stock purchase warrants of the airline company attached to the preferred stock of its parent concern, American Export Lines.

Cessna Aircraft Co. has reached a renegotiation agreement on 1942 earnings involving payment to the government of $5,688 000, according to Pres. Dwane Wallace. Sales volume for the nine months ended June 30 was around $65,000,000, compared with $37,000,000 in the previous fiscal year.

Earnings of some of the major airlines improved so substantially in the first half of 1943 that they are now in the excess profits tax brackets. American Airlines profits increased from $1,205,318 or $1.91 a share, in 1942 to only $1,359,915 or $2.16 a share in the six months to June 30. But taxes were up from $1,152,000 to $3,440 000. United Air Lines reported net of $2,153 400 or $1.44 a share in the first half of 1943 against $882,299 or 59c a share in the like 1942 period while TWA showed profits of $732,578 or 76c against $422 418 or 44c last year. As United reported taxes jumping from $583,000 to $1,744,000, Pres. Patterson stated that the company did not anticipate that it would be subject to excess profits taxes this year.

Recent stock offerings by investment bankers for public sale include 400 000 shares of Braniff Airways to secure $5 000 000 for the replacement of equipment requisitioned by the Army and for the purchase of additional equipment for trade-feeder and foreign routes.

Northeast Airlines is also financing its proposed route expansion both here and abroad through the sale through bankers of 200 000 shares of common stock to raise $1,400,000. Some 15 percent of the Northeast is owned by the Boston & Maine and Maine Central railroads. At the same time All American Aviation is marketing 20 488 shares of 4 percent convertible preferred stock to finance operations under government contracts and to liquidate certain outstanding obligations. All American has arranged a $1,000,000 V-loan which provides that no dividends will be paid, while obligations are outstanding, without consent of the Wilmington Trust Co., which arranged the loan.

Square D Co. has retired 1 450 shares of its preferred stock, and this company reports six months earnings of $1,155 175 or $2.65 a share against $1,548,178 or $3.57 a share.

Aircraft Accessories reports for the year ended Apr. 30, net income of $741 433 or $1.21 against $265 862 or 44c a share. Meanwhile, it has had converted into common stock all but 125 shares of its 21,51⁰ shares of preferred stock.

Fairchild Aviation has arranged to increase its V-loan from $5,000,000 to $15,000,000, according to Pres. James S. Ogsbury. Earnings for the six months to June 30 were $713,384 or $3.12 a share against $578,037 or $2.52 a share in 1942. A deduction of $2,843,200 was made for estimated renegotiation of 1943 business to June 30.

Bendix Aviation reports sales of $643,148,412 for the nine months ended June 30 against $297,684,361 in the like 1942 period. Profits were $11,995,931 or $5.67 a share against $11 005 022 or $5.22 a share in the same 1942 period. Unfilled orders were $1 042,000,000, showing little change from the March figure.

General Aircraft Corp. common stock has been acquired by Alleghany Corp., a holding company formed in 1929 to purchase railroad stocks. Details of the purchase were not divulged by Alleghany.

Aviation People



R RANDALL IRWIN for ten years industrial relations director of Lockheed and Vega Aircraft, was appointed executive assistant to the management members of the War Manpower Commission policy committee in Washington. He has been loaned by the Commission's request in view of his broad experience in industrial relations. Although he will give full time to the government work, at the same time he was appointed to the new position of assistant to the administrative vice president in the companies. WILLIAM McAULEPP (right) has been named industrial relations director for Lockheed and Vega.





FRANK A RUDOLPH has been appointed western regional manager of Aircraft Accessories Corp. He has been in charge of AAC offices in New York City for some time. Prior to his connection with the company he was affiliated with General Electric radio television & electronic Div.



Harris & Ewing Photo

CLINTON M HESTER, first administrator of the Civil Aeronautics Administration, has been named Washington Counsel for Chicago & Southern Air Lines. He has spent more than 20 yrs in seven departments of the Federal Government.



ROBERT J LINDQUIST v-p and director of Reynolds Metals since 1941, has joined Curtiss-Wright as a vice-president in charge of finances. He will assume complete handling of finances, along with the direct responsibility of implementing and carrying out company monetary policies.



Pan American Photo

MURLIN C ARNER who joined Pan American World Airways as a mechanic's helper 14 yrs ago, has been appointed center representative for the airline in Port of Spain, Trinidad, after three years as airport manager of Kingston, Jamaica.



Ryan Photo

NATHANIEL E WARMAN has joined Ryan Aeronautical as assistant to Chief Engineer Salmon, and one of his first assignments will be to work with the latter on the engineering of the new Navy combat-type plane.



HERVEY F LAW previously regional supervisor of airports for CAA, has been appointed manager of the Washington National Airport, succeeding "Johnny" Groves who has now joined the Air Transport Association.





CAA Photos

W. L. "JACK" NELSON has resigned as chief of the Aircraft Priorities Branch of WPB to accept an appointment as assistant director of the CAA War Training Service, in which capacity he will be special assistant to the executive director, R. McLean Stewart. CAA also announces that DONALD M. STUART (right) has been appointed chief of the technical development division and will have charge of CAA experimental work on aircraft, radio, airports, charts, and other wartime and postwar projects.



PAUL E. NOVGARD, veteran aeronautical engineer and former flight research and wing tunnel expert for Curtiss-Wright, has rejoined the organization as Airplane Div. at Buffalo as assistant to the director of engineering. A skilled test pilot and expert on rotary wing aircraft, he had also spent several years in wind tunnel and flight research for Curtiss-Wright. C.W. also announces that N. F. VANDERLIPP (right), production expert who for nearly two years has assisted in the manufacture of "Helldivers" in Canada, has been named factory manager at Columbus, replacing C. W. "Chuck" Hunter, now with the AAF.





THOMAS K PIERCE, formerly general manager of Dominion Plywoods, Ltd., has been appointed assistant general manager of the Duramold Div. Fairchild Engine & Airplane Corp. and will supervise Duramold's activities in plastic-plywood research, development, and production.



R. A. MERKLE has been appointed district traffic manager of Colonial Airlines in New York. For the past eight years he has been assistant district traffic manager of UAL in New York and prior to that he was with the traffic department of the N. Y. Central R. R.



CAPTAIN RALPH S. BARNABY, well known for his glider work experimentation, has recently been promoted from the rank of Commander, and he is now chief engineer of the Naval Aircraft Factory in Philadelphia, where for the past four years he has been asst. chief engineer.

Recent Books

VERTICAL WARFARE, by Francis Hilton Drake. Doubleday, Doran and Co., New York. 142 pages, illustrations, $3

With arithmetic this book makes victory look ripe for the taking. Since "it is quicker and cheaper," says Mr. Drake, "to overcome the enemy by going after his [industrial] heart with bombs than after his feet with gunfire," here is "the air plan" to do it.

The first rule is "an overwhelming, continuous, and crushing series of blows within a short period of time." This period is divided into two phases. In the first, 3,000 RAF and AAF bombers—twice the number now based in Britain—would drop on 1,000 plane attacks from 10,000 to 30,000 tons of bombs a month; this "would take from four to six months at the most to bring Germany to her knees." (Allied planes loosed an estimated 26,000 tons in July alone.) In the second phase, 2,000 operational planes would step tonnage up to 80,000 a month. "It is a tremendous undertaking, but we have already come so far along the road that success is almost within our grasp."

But the obvious fact to be remembered, however, is that Allied air commands also possess the same intelligence—in more detail. Anyone who thinks they do not realize the strength of their weapon has not paid sufficient attention to reports from the front. What should be done is limited by strategy and available materials. Exactly what can be done in war is known only when it happens. For, as Mr. Drake remarks, "A war has yet to be won either by rhetoric or slide rule."

AEROPLANES AND HOW THEY FLY. Longmans, Green and Co., New York. 44 pages, diagrams, paper bound, 40¢

Designed as an introduction to the theory of aeronautics, this pamphlet provides non-technical explanations of how balloons and planes get off the ground and how they are kept in and controlled in the air.

GROUND INSTRUCTOR, by Charles A. Zweng. Pan American Navigation Service, Hollywood, Calif. 336 pages, illustrations, index. Paper bound and lithographed, $3

AIRCRAFT AND ENGINE MECHANICS' MANUAL, by the same author and publishers. 192 pages, illustrations, index. Paper bound and lithographed, $3

Intended to cover the material of the ground instructor basic course, Mr. Zweng's first book contains a short history of aviation and discussions of aircraft and theory of flight; power plants, instruments, navigation, meteorology, and civil air regulations and traffic rules. The mechanics' manual is designed as preparation for obtaining a rating. It is divided into three detailed question-and-answer sections on civil air regulations, aircraft, and engines.

PHYSIOLOGY IN AVIATION, by Chalmers L. Gemmill, M.D., Charles C. Thomas, Springfield, Ill. 420 pages, fig ures, tables, index, $2

Without technical, anatomical references, this book presents in brief, straightforward chapters the effects of flight upon respiration, circulation, and other body functions. The material is based upon lectures given at the school of aviation medicine, Pensacola, Fla., where the author is an instructor in physiology.

AIRPLANE STRUCTURES, VOL. I, by Alfred S. Niles and Joseph S. Newell. Third Edition, John Wiley and Sons, New York. 454 pages, index, $4.50

For "students well qualified in mathematics and mechanics," this text is the first of two in a course estimated to require about 200 hr. of lectures and 400 hr. outside study by graduates. Its descriptions and analyses are almost wholly mathematical with further problems to develop proficiency in computing, solving, and analyzing. Contents contain various articles on general design procedure; critical loading conditions, reactions, shears, moments, and influence lines; beam deflections; continuous and restrained beams; design of simple beams; torsion; truss analysis; graphical methods; design of simple ties and columns; connections; and deflections.

GOD IS MY CO-PILOT, by Col. Robert L. Scott. Charles Scribner's Sons, New York. 277 pages. $2.50

This one-time commander of fighter pilots in Maj. Gen. Chennault's China Air Force is a flyer's flyer who can really write. Result is what many are calling the best fighting aviation book yet to come out of this war.

From early boyhood, Scott knew what he wanted—to be a fighter pilot—and his whole life was aimed in that direction, even though an irrepressibly adventuresome spirit nearly got him "off the beam" several times. For several years he was "too young" to lead a squadron or even a flight then, when the Japs brought the line, he suddenly found himself, at 34, "too old to fly a fighter plane into combat." Which meant Scott had to get in the war the hard way, by taking a bomber to India—where a secret mission blew up in his face—then working with the Ferry Command as a transport pilot (sometimes even as co-pilot), chiseling him self a Curtiss P-40 with which he became Burma's "one man air force," and finally joining Chennault when the AVG was absorbed by the Army.

Of him the General says, "The only criticism of his actions as Group Commander was that he consistently scheduled himself as pilot on all possible missions. He led all types of combat missions but specialized in the most dangerous." Scott almost makes himself sound like the original "eager beaver". The country the Air Forces, and the reading public could certainly do with a bit more of his type.

BASIC ELECTRICITY FOR COMMUNICATIONS, by William H. Timbie. John Wiley and Sons, New York. 603 pages, index, drawings, $3.50

Omitting general theory and history, this text deals with practical principles useful to the worker in communications and industrial electronics, including simple explanations and example-problems on Ohm's law, power and energy, conductors, measurement of resistance, batteries, generators, and motors.

WINGS FOR AMERICA, by Marshall Dana and Lloyd A. Morrisett. World Book Co., Yonkers, N. Y. 244 pages, index, glossary, $1

Primer on transport operations the story of flight, military flying, meteorology, manufacturing, and air geography for school children.

INTRODUCTION TO SEA AND AIR NAVIGATION, by B. M. Smart. Longmans Green & Co., New York. 114 pages, index, drawings. $1.50

ASTRONOMICAL NAVIGATION, by the same author and publishers. 120 pages, index, drawings, $1.90

Succinct expositions of principles including, in the first volume, dead reckoning, determinations of positions, effects of wind and, in the second volume (which covers an RAF cadet lecture course), the astronomical triangle, Greenwich mean time, and the observation of altitudes.

The Case for the Integral Power Plant

(*Continued from page 150*)

While all the arrangements would not apply to all of the engines, it is quite possible that as many as 40 'standardized' combinations would eventually be needed.

"Reference was made to locating the power plant in the front section of the nacelle. This is only one of a number of places where the power plant can be put. Other locations being used are: The rear of the nacelle, the front of the fuselage, inside the fuselage, and inside the wing. In order to overlook no possible arrangement having its proponents, power plants may also soon be seen in the rear of the fuselage. Each position requires individual cowling and different ducting involving many basic variations in installation.

"Looking now at the other side of the coin, there is a great deal to be said for setting a limited objective along the path indicated by Dr. Moss. It has been obvious to many within the industry that in time of war parallel work by a number of different manufacturers with the same personnel on problems is wasteful. To a very limited extent this has been reduced by the interchange of information between manufacturers and to a somewhat greater extent by the migration of personnel. Much more could and should be done to prevent this wasted effort, particularly since personnel migration is being largely checked.

"There seems to be little doubt that in time of war such procedure could considerably accelerate the development of new aircraft and result in more and better airplanes. It is suggested that there is ample opportunity for carrying this a great deal further."

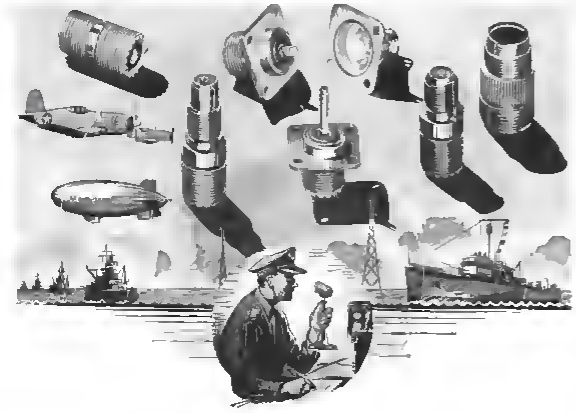
Louis E. Bourne, of the Fisher Body Detroit Div., General Motors Corp.:

"There are a great many of us who realize that we have for some time practiced in this country what might be reasonably called a quick change of the engine itself, but aside from general discussion and experimental work on a small scale, nothing has actually been done in the matter of producing a quick-change of the power plant unit, even though we are in the main, open minded and production conscious.

"The most advantageous possibility it seems me, in considering the subject as the interchangeability of power plant units of the same or similar design in one type of bomber or cargo plane. During war we like to maintain a bomber in flyable condition at all times. A badly damaged inoperable power plant could be more quickly replaced than repaired in most instances, if the quick change power plant unit were used. It no doubt would be far better to change a power plant quickly by this method than to attempt replacement or repair of a power plant part, meanwhile holding up the whole airplane.

"The peacetime counterpart in maintaining flyable aircraft is obvious. We have, even now, several airplanes which are quite well adaptable to this type of power plant installation without appreciable change of anything except the attaching point, instead of concentrating on quick-change of the engine alone, it seems advisable to drop back a few more feet and take in, perhaps, the nacelle proper, which could possibly include all the immediate power plant accessories and others such as would comprise the entire engine oil and induction systems. This thing is not such a remote possibility. The necessity for it will bring about actual realization.

"The accomplishment to be gained as the result of determined study on this subject would indeed be of amazing value and quite an eye-opener. However, there is more than just power plant packaging lying beneath the surface of the subject, there is also, among



CONNECTORS

IN THE "*Life Line*" OF RADIO EQUIPMENT

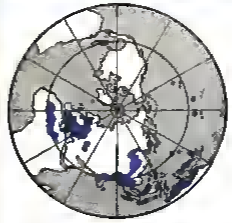
★ ★ Astatic Co-axial Cable Connectors are playing their part in keeping open the "life line" of radio communications on many battlefronts. Manufactured in the many sizes and shapes required for radio wartime equipment, Astatic Cable Connectors provide secure, lock-tight contacts for increased speed in installation and high operating efficiency. Designed to conform with exacting government standards, Astatic Co-axial Cable Connectors are used and highly praised by many leading radio manufacturers. Increased production facilities assure prompt deliveries.

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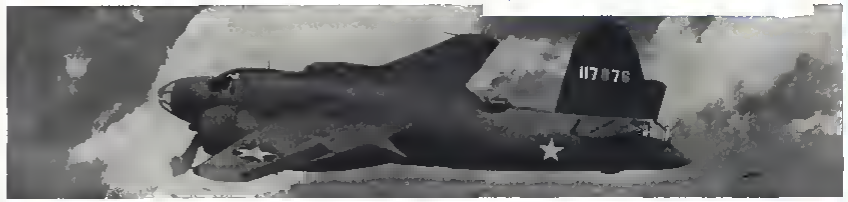
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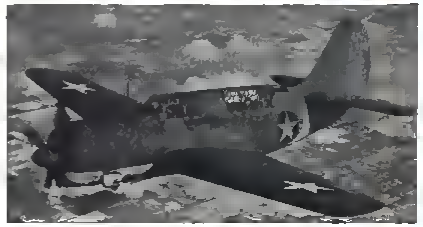
Hyland-equipped aircraft of many leading manufacturers are now on active duty in the combat areas shown on map (left), and at training fields here and abroad. This is the second in a series of advertisements presenting Hyland-equipped **ATTACK BOMBERS**



ONE OF THE FASTEST and most versatile medium bombers is the Hyland-equipped MARTIN B-26, used successfully in attack on many fronts. Combined bombing, fighting and strafing power made it a formidable weapon in the winning of Tunisia.



"THE SEAGULL" two-place, CURTISS monoplane is for catapult launching at sea or for long range patrol from land. It carries bombs or depth charges for long range submarine attacks.



LARGER BOMB LOADS are carried faster and farther by this CURTISS "Helldiver" than by any other single engine dive bomber now in service, according to its designers . . . and operates from carrier or land bases.



ON THE ATTACK, this Navy dive bomber, the DOUGLAS "Dauntless," plays havoc with Axis forces. It is one of the deadliest bombers in combat service. Note brake flaps silhouetted as it rises to battle (left).

BRITISH dive bombing on enemy objectives is effectively carried out by the well known American made BREWSTER "Bermuda". The Hyland-equipped "Bermuda" (right) is shown in full war paint.



Hyland employees are proud of this flag. It displays the united loyalty of every worker.

Since 1928 aircraft parts have been our business . . . from the very first, when The Hyland Machine Company was organized to serve the Army Air Corps, we have specialized in aircraft control parts. You will find our manufacturing facilities and unusual service worth investigating. Phone, write or wire today for the new Hyland Catalog.



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DAYTON, OHIO

nther things, general standardizatnm possibilities and service life cnnputation of various parts

"Time spent by a committee on this subject would surely be well worth while."

Col. George C. Crom, of the Army Air Forces Materiel Command, Wright Field—

"The idea of a unit power plant, integral and interchangeable, is a very logical one. It presupposes the layout of the engine and all its auxiliary apparatus by experts familiar with each part, with supervision by competent engineers such that each part has proper consideration for the operation of the other auxiliary plants. If the integral power plant were available at the present time, it would be of great benefit in the battles now being waged against our enemies.

"It seems essential in the development of the unit power plant that the aim be to incorporate all those devices that will increase the overall efficiency of the power plant. The turbosupercharger, which largely utilizes waste power from the engine, definitely should be a part of the power plant.

"The proper utilization of the integral power plant can only be accomplished by unit type of control, which will allow the most efficient operation of the entire power plant when efficiency is desired, and also will allow the maximum power when maximum power is desired."

T. P. Hall, chief development engineer, Consolidated Vultee Aircraft Corp.:

"For certain types of airplanes, built and employed in large numbers under wartime conditions, the adoption of integral power plants is desirable in the interest of production and maintenance alike. This is particularly true for large multi-engine airplanes with aircooled engines.

"The problems pertaining to the creation of specifications and designs acceptable to all parties concerned could be handled through the Society of Automotive Engineers or the Aeronautical Chamber of Commerce of America.

"The integral power plant should include all the equipment needed for the propulsion of the airplane, fore and aft of the firewall. A certain flexibility of design with regard to the location of turbosuperchargers, intercoolers, and oil coolers will be necessary, in order to make a given integral power plant applicable to various installations with only minor changes in the arrangement of the ducts. Standard attachments should be provided for those accessories, which may vary with the type of aircraft. It will be necessary to overcome some unavoidable patent difficulties.

"An obvious advantage of the integral plant is its interchangeability in case of a major failure. It should be possible, however, to simplify assembly and maintenance work by well-planned designs since the entire power plant will be designed by a single engineering group for each integral type.

"It is expected that the integral power plants will be assembled by the aircraft manufacturers or their specialized subcontractors. This will be necessary to prevent dislocations of the present production set-up and to avoid unnecessary shipping of parts and accessories back and forth across the continent.

"It is our opinion that the creation of integral power plants is a result of the present military necessity of obtaining a great number of standardized airplanes. We feel that the standardization of certain power plant installations should not be allowed to interfere with a continued progress in the design of new and unusual airplanes and power plants.

"A discussion of the possibilities of the integral power plant for commercial purposes appears to be premature at this time."

Engineering of Integral Plants

So far as can be told from current literature, the engine builders have taken the initiative with the integral power plant plan in both England and Germany. But an opposing idea suggested that the initiative for creating integral power plant design must remain with the plane builder along with the responsibility.

But in any event the integral power plant plan would best be executed by specialized groups devoting themselves exclusively to the design and manufacture of integral power plants. The designers and manufacturers who are producing modern airplanes have done a wonderful job, but the complications are getting greater and greater. The integral power plant plan would advance the arrangement, which already exists to some extent, of specialization by independent experts, in design and manufacture for (1) airplane design and construction, (2) airplane engines, (3) turbosuperchargers, (4) propellers, (5) generators, and other airplane accessories, (6) assembly of (2), (3), (4) and (5) as the integral power plant.

Such specialization already has come about in the design of steam power plants, and specialists design and erect an entire power plant, including boilers, engines, and all accessories. Exigences of war now have introduced a similar plan so far as manufacture of only one aviation power plant is concerned, and all power plants for a certain type of plane now are being assembled and tested in a single factory and supplied to various other manufacturers among whom the production of the plane has been divided.

Execution of the proposed plan may result in cutting a short from the present aeronautical stem and starting to grow it as a separate integral power plant tree. As science and engineering have progressed in the past century or so, engineering groups often have been subdivided in this way. Once there were only military and civil engineers. Then as engineering complexity increased, there budded off from the parent stem of civil engineering shoots which have grown into mining engineers, mechanical engineers, electrical engineers and, recently, steam power-plant engineers. Engineering of water ships (we now have to say it this way) is divided between marine engineers and naval architects. The rapid increase of complexity of the airplane, since the Kitty Hawk model of 1903, would seem to demand similar specialization of the airplane and the power plant groups.

Standardized Power Plant Plan

A number of gentlemen have been kind enough to provide the written discussions which have been quoted, for which the author is greatly obliged.

There seems to be no serious difficulty with the integral power plant plan, except possibly for single engine



Turner can now deliver rush orders on their plug, snap, flush pin and built up gauges. To facilitate deliveries we advise that you send blueprints and complete detailed information with your purchase order. For descriptive literature and prices on Turner's complete line of gauges write us today. (On your company stationery, please.)

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Built in standard, interchangeable 10-foot sections, BullDog BUStribution DUCT provides *complete flexibility* on branch power and lighting circuits. The plug-in feature enables you to change production machines at will—rearrange whole departments without interrupting production elsewhere.

BUStribution DUCT is quickly and easily installed—makes sensational savings in maintenance.

Capacities available for Plug-in Type Duct under new WPB standards are 250A, 400A and 600A.



PLUG-IN TYPE for Branch Circuits

(left) End view of branch circuit plug mounted on a bus duct section—showing how copper "contact fingers" clamp over the busbars in the duct. Plugs are readily interchangeable. Capacities 30A to 600A, 600 Volts or less.

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Ventilated type LO-X Duct for Feeder runs also shares all the basic advantages of BullDog's famous BUStribution DUCT design. It is quickly and easily installed—has full asset value—is 100% salvable. Available in the new WPB ratings of 800A, 1000A, 1350A, 1600A and 2000A. Single-phase, 3-phase, and 3-phase 4-wire; 600 Volts or less.

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LIGHTER THAN ANY OTHERS OF EQUAL RATING

Balanced armature construction increases their ability to withstand vibration, while permitting a reduction in weight.

TWO FORMS AVAILABLE—one which conforms to specifications of the U.S. Army Air Forces, one with simplified mounting and terminal arrangement (as illustrated) which saves additional weight and space

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ALTITUDE RANGE—0 to 40,000 feet

LINEAR ACCELERATION—Up to 10 G applied in any direction

VIBRATION—Meets U.S. Government vibration specifications

CORROSION-RESISTANT—They meet 200-hour salt-spray test as stipulated by various Government agencies

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AIRCRAFT CONTROL

GENERAL ELECTRIC

planes. Difficulties that seem to be feared are mostly as regards standardization. A definite plan for this which would seem to meet most of the objections mentioned (see Fig. 1) and the details, resulting from the discussions, are as follows.

The integral power plant plan means that the symetric which has been called the "engine mount" now becomes a "power plant mount" with four bosses, which carries the whole power plant. A part of the airplane is some sort of structure which supports four other mount bosses to which the power plant mount bosses are attached. This may be called the "plane support for power plant mount." This general plan of the two attached sets each of four bosses, is readily standardized, and it would seem easy to take the only remaining step.

This is that center-distance and thickness of these mount bosses be standardized for each general type and/or horsepower of airplane assembly, on both the power plant mount and the plane support for power plant mount. The structure of the power plant, its mount, and of the airplane and its plane support for power plant mount, then can be as variable as different manufacturers want, so long as the center distances and thicknesses of both sets of bosses are standard for each type and/or horsepower.

Perhaps there might be needed standards for distances of center of gravity from the section of the mount bosses, for various weights of power plant, in order to preserve a standard moment of the power plant weight. Gasoline and electric and control connections also must be standardized.

Presumably there would be a firewall at this section of the mount bosses, perhaps as part of the power plant section. But the outer diameter of the nacelle at this point need not be standardized, it could be different with every particular combination of power-plant section and airplane. Then there would be a standard maximum outer diameter of the firewall somewhat less than the smallest one of the diameters of the nacelles of the various combinations. There then could be a non standard ring to extend the firewall to the nacelle diameter for each of the different combinations.

There also could be non standard designs of each cowl or outer skin, for each sort of power-plant section and each sort of airplane, extending to within a short distance on either side of a firewall at the mount bosses. There would then have to be a short cowl or skin section extending on either side of the firewall (different for each combination) in order to fair in with the non-standard skins of particular planes.

(*Turn to page* 282)



Reason for War Bonds

Each three dollars saved in War Bonds *today* means four dollars you'll have toward that family plane *tomorrow*. Meanwhile your dollars will not only help to win the war, but hold down prices at home.

{ On your postwar plane specify a constant speed, light-weight Wickwire Automatic Propeller, with its *fully* automatic pitch change }

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Further discussion might disclose better details of the general plan than here proposed by the author, who is not an airplane designer. But it would seem that the proposed standardization merely conforms the numerical order of the location of the mount bosses to power plant mount and plane support for power plant mount. There remains complete latitude for individual design of every essential part without any cramping of individual initiative of either plane builder or power plant designer.

Various plans of the integral and standardized type here proposed have been talked about, but the present paper is written because the author thinks the matter needs pushing. The proposition of putting such plans into execution reminds the writer of a cartoon published some years ago. A number of executives were standing in a circle, and each one, when asked who should undertake responsibility in a certain matter, pointed to the next one in the circle and said, "It's up to him".

One way to start might be the appointment of a committee of representatives, from the interested bodies, to study the situation. With existing experience here and abroad a definite proposal might be agreed upon for standardization of the items here proposed or of similar ones. Let's start.

Note: Part I readers are advised that through makeup error engines appear upside down on p. 141, Sept.—AVIATION.

Airline Maintenance

(*Continued from page 215*)

Racks holding cleaned components move through inspection to the overhaul division. Cylinder rings are lapped in the cylinder by a Pratt & Whitney compressed air lapping machine, with a dummy piston redesigned in the shop. New and overhauled piston rings are checked for accuracy of side contact in a fixture (also designed in the shop) which is actually a die with a fitted plunger ground to the taper of the ring side. An application of bluing to the seat and plunger shows, by print on the ring, how completely in contact it has been. A minimum of 65 percent is required.

Cylinder valve seats are ground in two Ball vertical positioners and grinders, while valves are ground at the bench. Upon completion, cylinder assembly begins on a wooden bench fixture which holds the cylinder while parts are installed. There is a paint spray booth for older type cylinders, with bath turntable and suspension hooks for holding assemblies when painting.

Assembly section of the shop consists of three main divisions for power section, front engine section, and rear section. Inspected and approved parts move through to this division, where they are brought together in subassemblies. From here they go to the assembly stands, of which there are seven for RCAF engines and six for company engines. Assembly dollies are of Northwest design slightly modified by TCA. They mount on to a rotating mounting ring, which can be locked in any position at rotation, fastened to a frame which can be turned by a quadrant and crank to set the engine horizontal, vertical, or at any position in between.

For company engines, which are all turbo-cyclone Wasps, assembly stands have been built which are actually jigs at the same time, with locating attachments for all connections and plumbing. These have been completely standardized by the engineering and maintenance department, making all these units perfectly interchangeable, reducing service and change labor to a minimum.

All fixtures and devices mentioned as built in the shop could never have been made without the services of the machine shop, one of the most completely equipped departments in any airline. Here TCA's relation to Canadian National Railroads makes the situation unique among airlines by giving access to excellent metal stocks—particularly valuable in these times—in the form of discarded locomotive pistons, tires, car axles, and such, as well as to the railroad foundry for castings.

An excellent machinist, C. H. Wilson, chief of the shop, has at his disposal the best of machine tool equipment, and he has turned out innumerable fixtures and tools used throughout the plant. Ingenious use of old propeller stock aluminum has also contributed its share in the form of fire irons, universal joints for crawl flap mechanisms, flanges, and also in jobs like plugging enlarged thermocouple holes in a cylinder to be rebored for a new tight fit.

Like the engine overhaul shop, the propeller department handles a large number of RCAF units, the three most in types being Hamilton Standard two- and three-blade, deHavilland Hydromatics (actually Hamiltons built under license), and Curtiss-Reid. Approximately 100 propellers a month pass through the shop. Equipment is most complete, including buffing fixtures, an Odgers straightener, two hand blade twisters, etching tanks, and heat treating tanks. On the latter, a more accurate temperature control was installed in the form of thermocouples at top and bottom of the tanks to assure an even temperature throughout length of the tank.

There are, further, blade balancing fixtures for mating into sets a feathering test bench, and balancing pits of modified company design. The supporting posts are sunk deeper than is customary into concrete to prevent all possibility of deflection. Instead of knife edges, the hardened steel mandrel rests on hard steel round bar stocks fitted with accurate screw adjustments.

Magnafluxing, a cadmium plating tank, a cadmium stripper tank which is merely the reverse of plating, and a Rotabrine vapor degreaser complete the equipment in this division.

The instrument repair division overhauls not only many types of American and English aircraft instruments for company and RCAF but English bomb sights as well. Units of all kinds passing through the shop every month number about 135. Equipment is up-to-date and includes a newly designed electrical test panel and all other necessary testing apparatus.

Philosophy of the engineering and maintenance department is clearly exemplified in the pattern of the maintenance schedule, which is laid out for all major work in terms of engine change periods. Checks Nos. 1 to 4 (the latter being the 200-hr. check including complete structural and control inspection) precede the 800-hr. engine change. Beyond this the plan is not to schedule a minimum engine change time, but rather to set this interval at a maximum allowable period, so that with every engine change period there will be time to include a regular amount of partial overhaul and modification according to indicated need.

In the type of operation encountered here, the continual flow of changes and improvements entailed by weather and natural necessity of being self-sufficient make this system impossible to keep pace with all that has to be done to keep the aircraft up to date. In the best of circumstances there is a continual backing up of engineering and maintenance changes waiting to be applied. If these were not incorporated at every opportunity, the time would soon come when the plane would be out for "the long count," prohibitive at any time, but most of all now when replacements are not yet in sight and traffic exceeds all records in volume and urgency.

Thus, at each 800-, 1,600-, and 2,400-hr. mark, a period of three to four days is set to accomplish all possible modification work, so that at the 3,200-hr. limit, when the wings come off, there is a minimum of major work to be done. The aircraft will not be tied up for an exorbitant interval, and time taken along the way can be more surely calculated and planned for. Similar to the UAL system, a revised trip record is in preparation which will keep track of all work done on every plane, as well as work required. This will provide a continuous record paralleling service on the ship.

For the efficiency of the airline and

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any such equipment as mobile field service shops, photographic or mapping trailers, hospital stations, radar or radio shelters, trucks, trailers or buses.. If you have *any* application for gasoline fired portable or permanent heating, ventilating or water heating installations, it will pay you to find out about

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The information is of particular interest to any manufacturer, buyer or user of mobile photo laboratories, field hospitals, truck or trailer mounted field service shops, trucks, trailers or busses, shelters for radar, radio or other delicate equipment or stores to be protected from cold or dampness. The Hunter Heater, time tested in efficient burning of any kind of gasoline from truck fuel to 100 octane, is ideal for heating or ventilating such equipment.



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The information bulletin, available on request, briefly describes the standard models, the basic principle of the burner and the general purposes for which they are suitable. It is called "Bulletin HA-2".



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its freedom from accidents, great credit goes to the original organizers for their determination and perseverance in seeing to it that the system was started off in only one way—the right way. Since that time, the work of the men trained by them has kept the company in the front line of airline operation.

Super Aluminum Alloys for Aircraft Structures

(*Continued from page 161*)

Effect of stresses on the corrosion rates of various 24S aluminum alloys pre-stretched and aged as previously outlined, have recently been investigated at the CVAC test laboratories. Even though aged 24S Alclad had been given a superior rating by the Aluminum Research Laboratories[9] in their recent very thorough research into this phenomenon of "stress cracking," the writer and his co-workers at San Diego have, notwithstanding, made some check tests which confirm the Alcoa findings.

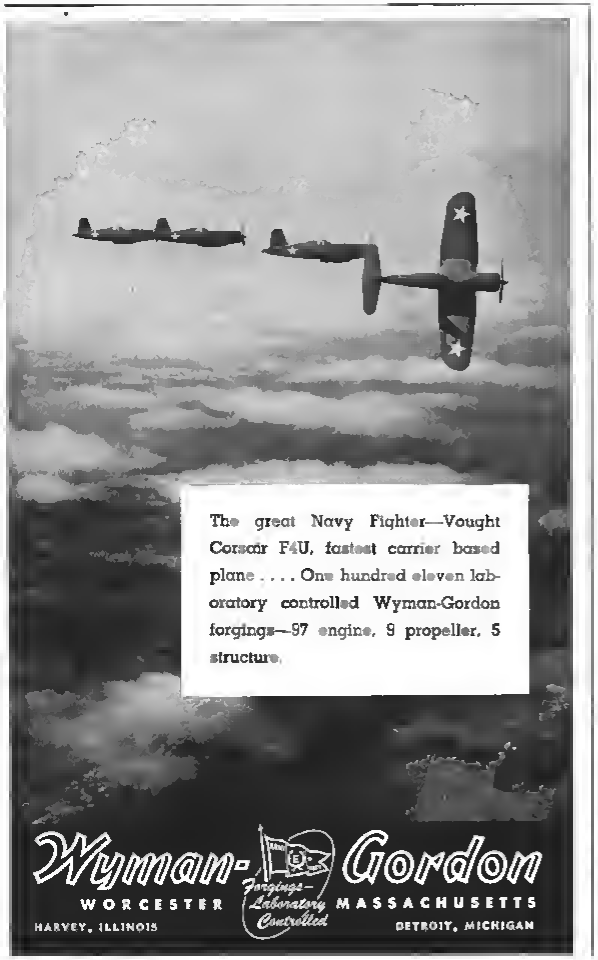
An ingenious method is used by CVAC, Alcoa, and others, to stress the coupons during the corrosion cycle. Fig. 25 shows some typical stress corrosion test specimens after 250 hr. of salt spray exposure. The components of the stress corrosion test jig are shown in the sketch accompanying Fig. 25. Two series of tests were made. One in which 0.064 x 1 x 8 in. 24ST Alclad, 24RT, 24ST8R3.5 Alclad (7 percent elongation) and 24ST8R3.5 Alclad (5 percent elongation) sheet specimens were subjected to a bending stress of 15,000 psi in the stress corrosion jig, and the other in which identical specimens of the same materials were stressed, by bending, to approximately 75 percent of their respective compressive yields during the corrosion cycles. The riser at the centerline of this jig consists of segments of rods of various dimensions, shown as in the profile view in sketch accompanying Fig. 25.

Considerable surface corrosion was evident in the unclad 24S specimens exposed for periods of 250 hr. and 30 days, respectively. The bending stress of 15,000 psi apparently is not sufficient to induce stress corrosion cracking in 24S aluminum alloy. The meager data in the second series of tests indicated that bending stresses of 75 percent of the compressive yield on aged 24S Alclad material will not cause stress corrosion cracking or intercrystalline separation.

Plate-Stringers and "Super-Aluminum Alloys"

With the broad subjects of cold-working and elevated temperature aging of 24S aluminum alloys briefly covered, the "proof of the pudding" is in the application of these new metallurgical and shop process findings to airplane structures. Reference is made to Table V for comparison of the mechanical properties of today's conventional 24S alloys with tomorrow's four new "super-aluminum alloys." Assuming that corrosion problems will necessitate dropping unclad 24ST for the time being, and that next year's passenger liners will use stretched and aged 24S Alclad material, comparisons of the materials shown in Table V are simplified to the four aluminum alloys that may appear in considerable quantity in planes of the future: 24ST Alclad "as received," 24RT Alclad, 24ST8 Alclad, and 24ST-8R3.5 Alclad.

Using today's most common aluminum alloy as a yardstick, let us compare 24ST Alclad "as received" with these new materials in an attempt to determine the weight-saving possibilities on future ships. It is probable that the *stringers* on the wings, fuselage, and metal-covered tail surfaces will be changed from the 24ST Alclad "as received"—now conventional with most aircraft manufacturers—to 24ST8R3.5 Alclad (24SO, heat treated, and aged). Coverings of these primary structures may or may not be fabricated of today's 24ST Alclad "as received," depending







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METAL PRODUCTS COMPANY
Cleveland, Ohio

upon the research findings of the next few months.

Some exploratory tests have already been made at CVAC to determine the desirability of using pre-stressed and aged sheet on structural plate-stringer combinations. Fig. 26 is ample proof that aging of aircraft structures is being placed on a practical basis at the Consolidated Vultee Aircraft Corp., San Diego Div. A test engineer is here shown pushing a frame, loosely stacked with plate-stringer test specimens, into a new air oven especially installed for the purpose of studying aluminum alloy aging and its associated fabrication problems. Note how carefully the test specimens have been placed to permit the circulation of heated air to all parts of the load, thereby maintaining uniformity of the resulting mechanical properties.

Table VI shows the test results obtainable on 30- to 40-in. long, flat-ended plate-stringers in compression, where both stiffeners and sheets were aged. The specimens were flat sheets, each sheet stiffened with three 1½-in. deep drawn 24S Alclad trapezoidal hat-stringers, as shown in the sketch accompanying Table VI. In each case the sheet extended beyond one outer rivet-row a distance equal to that between inner rivet-rows of adjacent hats. 24ST Alclad "as received" sheets and 24RT Alclad (24SO, heat treated and stretched to 3½ percent permanent set) hats were assembled by means of ⅞-in. dia., 100 deg. countersunk rivets, spaced at 1 or 1¼ in., as shown in Table VI.

An extra rivet was provided at a distance of ⅜ in. from the top and bottom edges of the sheet, to prevent local sheet instability. After riveting, the assembled specimens were aged at 355 deg. F. for 9 hr., then cooled in still air at room temperature. Thus, in the final tested condition, the specimens consisted of 24ST8 sheets and 24ST8R3.5 hat stiffeners.

Each sheet was weighed after being cut to size; each stock length of hat was trimmed, weighed, and its length measured. The cross-sectional areas of the sheets and hats were then calculated from their weight, length, and a density of 24S of 0.100 lb. per cu. in.

All test specimens were ground flat and parallel at the ends to insure uniform bearing on the platens of the 400,000-lb. hydraulic testing machine. The plate-stringer specimens were tested, flat-ended, to failure, on hardened steel bearing plates. During the test, the extended portion of the sheet of each specimen was restrained with a split low-carbon steel tube, having a wall thickness of approximately ¼ in., clamped to the specimen as shown in Fig. 8 presented in Part I of this series (page 154 Aug. AVIATION).

Samples of each sheet and stock

Auburn
CERAMIC
SPARK PLUG
CONNECTORS

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IN SIZE



a giant
IN IMPORTANCE

Only 1 inch long, 1/12th of an ounce in weight, but it packs a powerful punch in Aircraft Engine performance.

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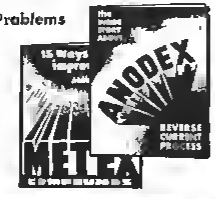
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length of hat were obtained prior to specimen assembly, and from them were cut, in duplicate, standard ½-in. tension and 1 x 3-in compression coupons. Remaining portions of the samples were aged with the specimens, after which additional tension and compression coupons were made. The coupons were tested in a 120,000-lb hydraulic testing machine. Tensile and compressive ("sandwich" method) yield strengths were obtained with an autographic stress-strain recorder. Elongation of each tension coupon was determined by the "divider method," after failure.

It will be noted, by reference to Table VI, that sheet tensile yield has been raised from approximately 40,000 psi. in the "as received" 24ST Alclad sheets to approximately 61,000 psi after the "355 deg F for 9 hr" aging treatment, a 25 percent increase. Elongation decreased from approximately 17 to 7 percent in 2 in. Compressive yield was increased from the "as-received" 41,000 psi. to approximately 62,000 psi., or 50 percent. The rolled hot-stringer 24RT Alclad material (after rolling in the 24SO condition, heat treatment, and production stretching to a 3½ percent permanent set) had a tensile yield of approximately 55,000 psi. The aging process increased tensile yield to approximately 69,000 psi., or 25 percent. At the same time compression yields increased from 45,000 to 70,000 psi. (or 55 percent), and elongations in a 2-in. length decreased from approximately 15 to 8 percent.

Unit stress developed by these few representative plate-stringers at failure varied from 48,000 psi. for the 0.125-in. gage sheet stiffened by 0.091-in. hats in a 31-in. specimen, to 30,000 psi. for the same combination in a 42-in. length. These specimen lengths are equivalent to wing structures at bulkhead spacings of 22 and 30 in.

While duplicate plate stringers fabricated from unaged and unstretched 24S Alclad material are not immediately available for comparison with Table VI test results, nevertheless an approximation of the benefits of aging on compression members can be made by reference to Fig. 27. On these typical compression stress-strain curves for 24S aluminum alloy sheets, compressive stress at a given strain of the specimen may be plotted as point *A* at 43,500 psi. If the material compressive yield were changed from 45,000 to 70,000 psi. by aging, the developed stress could be raised from point *A* to point *B* at the same strain; or, in this instance, 57,500 psi. To accomplish this increase in stress it might be necessary to prevent local buckling by decreasing the stringer spacing or by increasing the sheet gage.

(*Turn to page* 290)

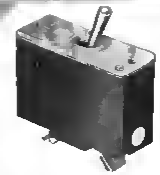
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ANTENNA SWITCH—Class 9320, Type 962. Single pole double throw. Provides aerial type selection. Weight, 1 lb. 5 oz.



CIRCUIT BREAKER—Class 9300, Type B. "On" and "Off" switching with circuit protection. 5 to 70 amperes. 30 volts, D.C. Weight, 2½ oz.



BOMB RELEASE—Class 9300, Type 1003. Single pole, normally open. Recessed push button. Selection of markings. Weight, 3 oz.



PUSH SWITCH—Class 9390, Type OM "Mushroom" button. Single pole, normally open or closed, as specified. Weight, 1½ oz.



MICROPHONE SWITCH—Class 9390, Type 987. Three point snap action contacts. Single pole, normally open with ground terminal. Weight, 1 oz.



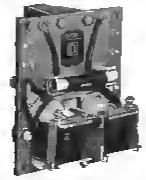
TRIGGER SWITCH—Class 9390, Type 981. Single pole, single throw finger control. For mounting on control wheel. Weight, 1 oz.



THUMB SWITCH—Class 9390, Type 986. Recessed button. Normally open or closed. Weight, 1¼ oz.



LEVER SWITCH—Class 9320, Type 991. Heavy duty for D. C. power circuits up to 125 amperes. Single pole, single throw. Weight, 9½ oz.



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Another interesting point illustrated in Fig. 27 is the benefit given the stability of formed sections by high compressum-yield materials. If the hat stiffener, for instance, with a compressive yield of 45,000 psi shows signs of instability under the plate-stringer strain of 0.0055 in./in., the application of an aging treatment to the hat, increasing its compressive yield to 70,000 psi., will benefit it in two ways. First, it will permit the hat material to work within the elastic range—with no resultant permanent set—whereas previously it would have set 0.0014 in./in.; and second, the tangent modulus at point *A* of the low yield material of 2,630,000 psi. would be raised almost to the conventional value of 10,700,000 psi. for equal strain (point *B*), or for equal stress (point *C*). Thus aging has improved both the compressive yield and the stability at the same time.

Comparison of increased strengths due to aging is complicated by the fact that the sheet in most instances is of one compressive yield and the stringers of another, as is illustrated in Table VI. In such cases, the load at failure will depend upon the ability of the weaker member to support its share of the load. Instability of any portion of a plate stringer specimen will nullify the theoretical gains that might be predicted by such shortcuts as Fig. 27, inasmuch as aging and cold working 24S aluminum alloy have negligible effects upon the modulus of elasticity.

Should anyone wish to investigate more fully the effects of material property changes on structural strength of fabricated aircraft parts, a better introductory reference cannot be recommended than a paper recently presented by H. Langhaar[9] of CVAC, at a recent IAS meeting in Los Angeles. In this publication, Langhaar has presented a set of column curves, to which the material property changes may be directly applied, to give the increased column allowable load.

It has been a "rule of thumb" at CVAC to assume that, when material compressive yields are raised 50 percent, the over-all gain in the compressum strength of plate-stringer combinations may be increased 30 percent.

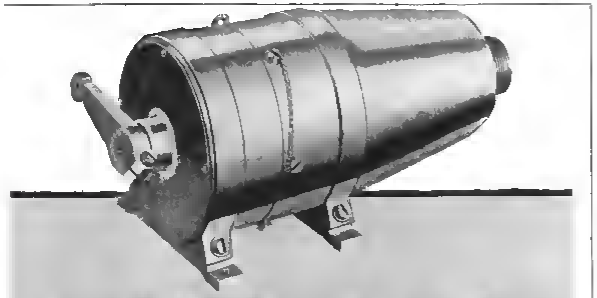
Statistical Data on 245 Alclad Sheet

Some meager test data are plotted in Fig. 28 to illustrate the probable spread of sheet mechanical property test results. Only a few hundred determinations are represented on these graphs, to be sure; but clustering of the tensile yield, tensile ultimate, and compressive yield stresses obtained through aging, and pre-stretching and aging, compared with specimen properties of 24ST Alclad "as received," is very evident. It will be noted also that the property spread for stretched and aged 24ST Alclad is less than on the original material, with the benefit of increased properties.

The 1945 "Altiliner" Reworked for Separ-Aluminum Alloys

With the information presented in Parts I, II, and in this issue on the effects of pre-stretching and aging upon 24S Alclad aluminum alloy, the weight breakdowns presented in Table I and Table II (presented in Part I) may be reanalyzed. It is assumed that the purchasing airline operating these *Altiliners* in 1945 will have such competent operating and flight personnel, and that the meteorology of the terrain over which the scheduled operations take place will be known to such a high degree, that it will not be necessary to maintain the present 40 to 50 percent spread between the material yield and ultimate strengths. The economical use of the super-aluminum alloys in tension will necessitate that the material factors be reduced to allow yields of 80 to 90 percent of the tension ultimate strengths to be used. Since the compressive yields and ultimates are many times simultaneous on plate stringers of conventional design, the material factor will not apply.

The use of the super-aluminum alloy 24ST8 Alclad for wing, fuselage, and tail *surface coverings* can be depended upon to give increases in yield proper-



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Photo, courtesy Lockheed Aircraft Corp

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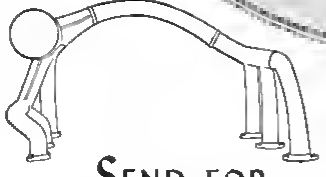


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ties over those of conventional 24ST Alclad "as received," in tension and compression of 27 and 36 percent, respectively. If it is assumed that tension and compression are equally important in designing wing and fuselage covering, depending upon the location where used, the probable weight saving might quite possibly be 20 percent on covering weights of such a large aircraft.

The *spars, ribs* and *bulkheads* itemized in Table I will probably require considerable forming, and they will therefore not be capable of being prestretched. Super-aluminum alloy 24ST-8RO is a probable choice for these members in our 1945 "giant," and it will probably net only 10 percent weight savings.

Fuselage *longerons* and wing and tail surface *stringers* obviously can be made of super aluminum alloy 24ST8R3.5 Alclad, inasmuch as the majority of such members are straight, or nearly so, and therefore they may be prestretched or cold worked by rollers to a 3½ percent permanent set before the aging process. Assuming that these members of Table I are designed by bending, tension, and compression in equal parts, the effective property increases may net 30 percent.

Summing up these weight savings possible by the use of appropriate super aluminum alloys, we, as joint designers of this 25,000 lb *Altitude*, can present the following weights:

Item	New Alloy	24ST Alclad Weight*	Super Aluminum Alloys % Saving	Weight Saving
Metal skin	24ST8 Alcla	17,925 lb.	20%	3,000 lb
Spars, ribs bulkheads	24ST8RO Alclad	12,700 lb.	10%	1,270 lb
Longerons stringers	24ST8R3.5 Alclad	10,520 lb	30%	3,160 lb.
			Possible Weight Saving	6,930 lb

*From Table I, Part 1, Aug. AVIATION

It therefore appears possible, even with the present limited knowledge of stretching and aging 24S Alclad aluminum alloys, that a saving of 8,000 lb, or 6 percent of the weight empty, is not beyond reason in the 1945 version of a 275,000 lb. *Altiliner*. This additional four tons of freight or passengers per flight tomorrow, should certainly merit immediate consideration of the "super-aluminum alloys" in designs on the drafting boards and in the test laboratories today.

References

(29) Nock, J. A., and Mears, R. B.—*Aluminum Research Laboratories Confidential Report 138—8—142, The Artificial Aging of 24S*, May 1943.

(30) Laughlin, H. L.—*Buckling of Aluminum Alloy Columns and Plates*. Paper presented before the Annual Meeting of the Institute of the Aeronautical Sciences, Los Angeles, Calif., Jan. 1943.

Note: For full tabulation of references for this series see pages 304-5, Part I, Aug. AVIATION. Errata: In references 5, 8, 10, 11, and 23 the name should read Jackman, K. B., in each case.

Holley Carburetor Operation

(*Continued from page* 211)

to restore fuel pressure at the carburetor even by using the wobble pump. The fuel pump should be set to deliver at a pressure of 6 to 7 lb. at the carburetor. This is important at higher powers when low fuel pressure will result in a lean mixture.

With the propeller in low pitch, the engine idling speed should be about 500 rpm. Lower speeds than this tend to cause spark plug fouling and rough running. If the engine is set to idle at too low a speed it may cut out entirely when the throttle is suddenly closed from higher power.

Loose or broken exhaust manifolding may cause poor metering by allowing the escaping exhaust to overheat the carburetor.

Air leaks in the induction system beyond the carburetor, either due to faulty assembly or backfires, will cause erratic engine operation. Continuous misfiring when starting indicates a mistake in valve timing.

For adjusting the power mixture valve for high power cruising operation, if the engine is equipped with a manifold pressure gauge, the valve should be set to give the highest manifold pressure at the desired r.p.m. and throttle opening. If the engine is not equipped with a manifold pressure gauge, the valve should be set to give the highest r.p.m. at the desired throttle opening.



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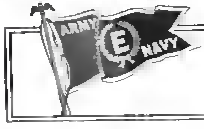
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...ion, the Bureau of Aeronautics advises as follows: "To insure opening of the power mixture valve and proper functioning of the mixture control when it is desired to use lean mixtures at or near the limit of such operations, the following is advised as a suitable procedure for lean cruising conditions—

1 Set desired rpm and manifold pressure
2 Set mixture control in automatic lean position.
3 Close throttle momentarily
4 Reset desired manifold pressure
5 Further adjust mixture control if necessary"

Carburetion

The following notes are intended to cover only those difficulties which may be encountered in field work. Overhaul and test bench work (too long for a magazine article) is covered in the *Holley Instruction Manual*, 3rd edition, Jan 1941.

At *low power and idle* the following defects give *rich mixture*: Stuck metering pin, fuel system flooding, vapor separator leaks, torn power mixture valve diaphragm, compensator needle leaks, metering pin or cam badly adjusted.

At *low power and idle* the following defects give *lean mixture*: Air leaks in carburetor fuel passages, metering pin or cam badly adjusted, leaks through acceleration pump valve.

At *high power, over rich mixture* is generally caused by clogged main air bleed.

At *cruising lean*, a rich mixture may be caused by: Power mixture valve stuck shut, clogged mixture disk or passages.

In the *compensator range* the following will give *rich mixture*: Fuel pressure too high, compensator spring needs adjustment, power mixture valve stuck shut.

In the *compensator range a lean mixture* may be caused by: Low fuel pressure, compensator spring needs adjustment, compensator venturi clogged or improperly seated, power mixture valve stuck open (will not return to full rich).

Poor idling may be due to: Idle adjustment not properly set, any of the above causes for too rich or too lean in low power range, throttle brushes not seating properly.

Faulty acceleration may be due to: Poor idling adjustment, acceleration pump check valve leaking, acceleration pump discharge nozzle leaking, pump lock plunger stuck in shut off position.

Failure of engine to shut off may be due to: Looseness or breakage in mixture control, mixture control passages clogged, acceleration pump lock valve not seating properly.

(*Turn to page 207*)



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Preparation for Storage

These instructions are for the purpose of protecting the diaphragms of the Holley carburetor from the injurious effects of stale gasoline during shipment or storage:

1 Remove the carburetor from the engine adapter. Place a wooden or metal cover on the adapter flange to protect the engine from dirt, etc.

2 Place the carburetor with drain plugs up. First remove the diaphragm vent chamber drain plug. Place carburetor in a vertical position and drain. Then replace the plug immediately. No oil should be placed in the chamber.

3 Reverse the position of carburetor and remove fuel chamber drain and accelerating pump chamber drain. Hold carburetor over a container to catch gasoline. With the carburetor in this position, open the throttles to vent the main fuel body and with a fingernail open the accelerator pump nozzle valve to vent the pump chamber. Hold in this position until all the fuel is drained from the carburetor.

4 Invert the carburetor again and close the throttles. Use a small funnel to fill the main fuel body and the accelerator pump chamber with oil conforming to specification AN-VV-O-446, not heavier than 1065.

5 Return the carburetor to an upright position and drain the oil. Plug the fuel inlet, the gasoline pressure inlet, and replace and lockwire all drain plugs. Remove the rear cam cover, open the throttle, and apply oil to the exposed portions of the metering pin, metering pin yoke, the exposed cam surface, the cam roller and pin. Replace cam and cover, close the throttles, and wire them in the closed position.

6 If the carburetor is to be stored for a considerable time, or if it is to be exposed to salt water, spray the outside with flushing oil.

7 Wrap in waterproof paper and fasten firmly in a strong wooden box.

Reconditioning After Storage

1 Clean the outside first with gasoline and a lintless rag. Remove the fuel chamber drain plug and the accelerating pump chamber drain, but do not yet remove the diaphragm vent chamber drain. Drain the oil and flush the diaphragms with gasoline of the type used in service. Do not use cleaning fluids of any kind inside the carburetor for they destroy the material of the diaphragms. Replace the plugs and remove the diaphragm vent chamber drain. Drain any oil or moisture that may have collected behind the di-



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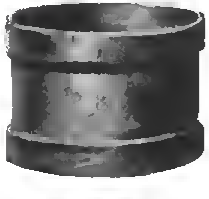
CATALOG 400-M



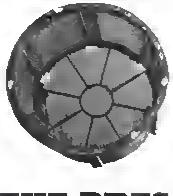
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aphragms. Replace the plug and lockwire.

2. Close the throttles and place the carburetor with the fuel inlet up. Remove the fuel inlet plug and fill the fuel chamber with gasoline, replacing the fuel inlet plug before the carburetor is returned to an upright position. As the diaphragms have a tendency to stiffen in storage, they should be allowed to stand for about ten hours with fuel in the fuel chamber, so as to soak the diaphragms and restore their flexibility.

3. Remove the cam cover, open the throttles, and generously oil the exposed surfaces of the metering pin, pin yoke, cam surface, cam roller, and pin.

4. Inspect the carburetor to make sure all plugs have been replaced and securely lockwired before it is installed on an engine.

Lockheed Oversees Keeps 'Em Flying

(*Continued from page* 113)

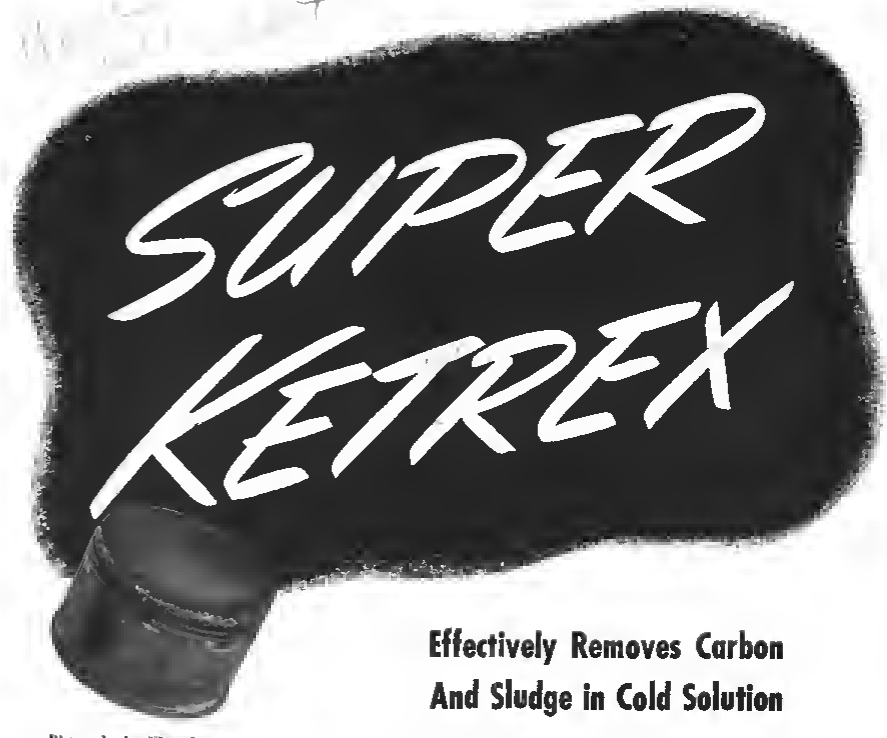
crews with the squadrons.

Major problem is the repair of aircraft and equipment damaged in battle or operations, the overhaul and repair of engines and equipment, and the expeditious return to service of the greatest possible amount of equipment. Each piece of equipment returned to service overseas is one less that need be manufactured and transported.

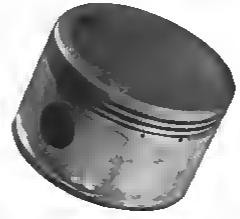
An analysis of the problem will not disclose an over all answer to the entire problem, but there is a group of applicable solutions which, used as a general plan of maintenance, will keep the greater percentage of our aircraft overseas in the air. The problem quickly resolves itself into four types of operations:

1. *The base repair, overhaul, and modification plant.* Here are concentrated the highly skilled technicians for the overhaul and repair of every type of aviation equipment. The location of the base must be within easy surface or air transport range of the operational activities. It is not contemplated that a great many damaged aircraft be repaired at these bases. Transportation of damaged aircraft through jungles, over deserts, or snow covered mountains is a problem too difficult to cope with in this war. They must be repaired on the spot.

Primary function of base operation is the overhaul and reconditioning of aircraft engines, propellers, assemblies, and accessories which can be transported. Transportation of large components, such as wings, tail groups, or even fighter and light bomber fuselages, could be accomplished in a special type



Piston looks like this (unretouched photo) after a workout in a Hornet Series A-2 Engine.



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of glider designed to carry materials large in span and volume but light in weight. The base must further serve as a manufacturing center for building modification parts and for the installation of modifications on aircraft flown to the base for the purpose of securing tactical changes.

Here, in a place relatively safe from enemy attacks, should be concentrated the valuable and complex equipment required to overhaul and test our engines, propellers, instruments, and the myriad accessories that constitute the present-day fighting aircraft. Transport to and from the base are essentials of its operation. Such a base should consist of no more than 3,000 men, of which 2,000 would be direct productive labor. All of the 2,000 men should be trained in specific skills of repair and manufacturing.

When the demands on the base require more than 3,000 men, another base should be built in another strategic spot. Limiting the size of the bases tends toward economy of construction and control of operation, and if it should be necessary to move the base, the transfer of equipment and personnel could be quickly accomplished.

2. *Advanced "sub-base" operation* calls for men trained in minor repair and the removal and installation of components. These crews should not concern themselves with the overhaul or repair of the unit removed but would engage in returning the aircraft to the air as quickly as possible, using units transported from the base depot. Units removed would then be returned to the base for reconditioning and overhaul, later to be used in the repair of other aircraft.

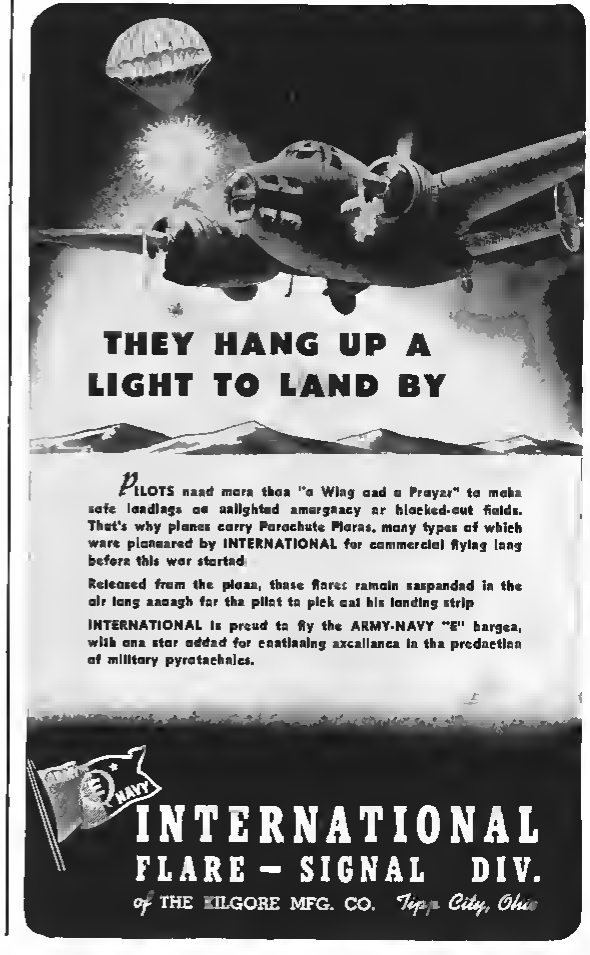
The extent to which such a group should engage in the actual repair of aircraft should be limited. If battle damage could not be corrected during the time of normal service operations, no further effort to return the aircraft to service should be made by the advanced base. The aircraft would then be replaced by a reserve aircraft, with the damaged plane turned over to a "mobile repair unit."

3. *The mobile repair unit* is without question one of the most valuable adjuncts to the maintenance of aircraft in this fast moving war; it may be mobile by air, land, or water, as the requirements of the theater dictate. In general, however, the unit consists of complete repair shops in trailers, with living accommodations for the crew, numbering 24 picked specialists, of which a qualified inspector and a stress engineer are important personnel. Repairs from severe battle damage or crash landings are engineered and installed on the spot. Repair schemes have been standardized to the extent that repair parts for every conceivable operation may be carried in the unit. Major assemblies are removed and returned to the base depot, and new or rebuilt units are installed.

Thus, the advanced depots and operational crews may be relieved of the necessity of carrying out complex repairs. In operations such as our African campaign, the units could be assigned to operational activities and move with the Air Forces squadrons. There is little doubt that a number of well equipped, well staffed mobile repair units would decrease measurably the number of aircraft replacements required for our fighting fronts.

4. *Fourth type of operation is the daily operational service of undamaged aircraft.* This function is carried out by the squadron maintenance crews, and if the aforementioned facilities are available, men with relatively little training can do the work.

To divide the job of maintenance into so many functions may seem to confuse what, to the experts appears to be a relatively simple matter. This simple matter, however, has suddenly assumed Gargantuan proportions, requiring organization on a proportionately large scale. We must not underestimate the size of the job of maintaining the thousands of airplanes we are building. That job has blossomed overnight into





the which may quickly become more difficult than has been the job of production.

The author has recently been privileged to observe the operation in the Eighth Air Forces area in the United Kingdom of the base type of operation and the mobile repair unit. Lockheed Overseas Corp., a division of Lockheed Vega Service, is operating both types of units for the Army Air Forces.

Flexibility of the base type of operation is adequately demonstrated by the North Ireland repair base operated by Lockheed Overseas Corp. for the Air Service Command. Built and staffed in six months' time, the base carries out just such operations as described above. Under the management of Henry Ogden, who pioneered air bases in England for Lockheed in 1939, the effectiveness of the small "concentrated skill" type of base has been definitely established.

Mobile repair units operated from the Lockheed Overseas Corp. base in Ireland move from point to point in England, effecting repairs wherever directed by the Air Service Command. The system has proven to be eminently successful in returning damaged aircraft to the air, and these units will certainly return to service a larger quantity of aircraft than any other single instrument of maintenance.

By no means will the establishment of such a system be the future answer to our maintenance problems, but it will, however, simplify many of our toughest problems. For example, a closely controlled rotation of parts from the mobile units and the advanced base to the base depot will obviate the necessity of having vast stocks of parts scattered among operating units. A standardization of tools for all types of aircraft is easily effected, and thus a highly desirable goal is accomplished.

Concentration of skills in the places where they are most effective is accomplished by establishing definite lines of demarcation between base, advanced, mobile, and operational repair functions. High types of skills are too scarce to spread thinly, hence concentration of the experts is desirable.

We have learned lessons in large scale maintenance the hard fast way overseas, where victory or defeat depends on the availability of every aircraft. Lockheed has been fortunate to have had a part in some of these activities. Out of Lockheed's overseas participation have emerged over 6,000 service-hardened, skilled men who have contributed their knowledge and work to breaking down barriers to rapid and expert maintenance. The lessons we have learned are valuable, and they should be developed toward solving further problems of keeping our planes in the air.

(*Turn to page* 305)



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Building the AAF

(*Continued from page* 231)

with advanced studies of aviation, radio, meteorology, plane and naval vessel identification, and other allied subjects. A large portion of the first hours in the air is occupied with takeoffs and landings. Later in the course the student officer gets cross-country trips, night and instrument flying, and hours in combat formation.

When he has graduated as a first pilot from Laughlin Field, the flyer knows every part of the B-26 from the simplest bolt to the secrets of the propeller mechanism. And he has learned the truth of the statement made by Lieut. Col. James E. Roberts, director of flying: "It doesn't take a superman to fly the B-26—but it *does* take a man who is wide awake, intelligent, and forever on the alert".

Before seeing action in the *Mitchell* or *Marauder*, graduates of Transition Schools are assigned to Operational Training Units, where combat crews are formed. Here they get a final tactical brushing-up. And when the pilot finally points the nose of one of these planes toward the enemy, he has won his "M" as a first string man, ready to fly almost anything with wings.

Air Transport Charts Routes

(*Continued from page* 200)

ceding paragraphs, a rapid development in the transportation of commodities by air should not be contingent upon direct government assistance.

Passenger Traffic

In the ten-year period prior to the end of 1940, revenue passenger-miles flown on scheduled domestic airlines increased from less than 1 percent to approximately 12 percent of Pullman passenger-miles. While much of this air traffic represents a diversion from rail and highway travel, a substantial portion undoubtedly is genuinely new traffic, brought into being by the acceleration which air transportation affords.

Half the airline passengers travel less than 300 mi. The average air journey is not as far as a typical trip by Pullman (491 versus 550 mi.). Passenger travel is much more highly concentrated in the eastern industrial area than is mail traffic.

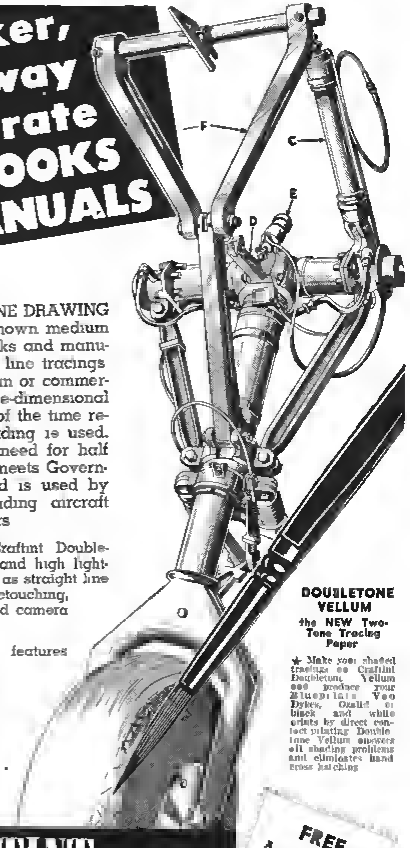
TABLE II—ESTIMATED POTENTIAL DOMESTIC AIR CARRIER TRAFFIC AND REVENUES

Type of traffic	Present (fiscal year 1940) annual traffic*	Approximate ratio of future to present (estimated)	Future annual traffic (next decade)	Assumed future average revenue per ton-mile	Future gross annual revenue
	Ton-Miles		Ton-Miles		
Passengers	$53 100 000	7	600 000 000	$0 3¾	$200 000 000
Commodities	3 000 000	180	550 000 000	18	100 000 000
Mail	8 400 000	7	65 000 000	1 00*	65 000 000
Totals and averages	87 900 000	12 4	1 215 000 000		365 000 000
Average charge per ton-mile	$0 66	45		$0 30	

* Average mail revenue is estimated on basis of two-thirds of mail carried at an average compensation of 50c. per gross ton mile and one-third (on light feeder routes) at an average compensation of 10 to 15c. per plane-mile for an average mail load of 150 to 250 lb., or $2 per mail ton-mile. At this rate, gross additional transportation expenses to the Post Office for country-wide expedite l mail service would be in the neighborhood of $34 000,000, most of which would go for rural delivery airmail routes.

For many years passenger traffic was so subject to seasonal variation that it used to be said that airlines spent

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their summers trying to recover from their winters. Fortunately, this winter hug-a-boo is rapidly ceasing to be an important factor. Revenue passenger-miles in Jan., 1940, for example, were almost four-fifths as great as the monthly average for the fiscal year 1940. Most important in increasing passenger traffic has been the remarkable advance in safety. Extrapolating the general safety curves for both air and rail carriers suggests that the two safety trends will merge by 1950.

Prior to 1930, airline passenger rates were approximately three times higher than Pullman fares. Today they average some 60 percent higher. Average airline costs per capacity seat mile are trending toward the 1.5 to 2c. range and load factors toward 60 percent. Hence, an average airline charge not much, if any, above 3c. per mile appears to be in sight within a predictable future.

It might well be argued that with no great difference in safety, with equal convenience, and with roughly equivalent rates, the great time advantage of the airlines will ultimately attract substantially all first-class long haul passenger traffic to air travel. This does not imply that Pullman travel would disappear, for it would remain more convenient for much short haul traffic. Much of the increase in airline traffic would represent newly created travel, or diversion from other sources.

As a generous margin of conservatism, let us assume that within the next decade or two air travel in the United States will assume proportions equivalent to approximately 70 percent of present day Pullman rail travel, or about 6 billion revenue passenger-miles. This would represent a sevenfold increase over the passenger miles flown by domestic air carriers during the fiscal year 1940. The resulting combined potential traffic in passengers, mail, and commodities are summarized in Table II.

Thus, under favorable circumstances it appears possible that within the next 10 or 20 yr. domestic air traffic may increase some twelvefold with a corresponding five to sixfold increase in gross operating revenues. The resulting traffic volume would be well over a billion ton miles per year, the annual gross income $300,000,000 or $400,000,000.

This is a rough measure of the potential domestic industry—exclusive of operations on foreign air routes—to which the government's transportation policy should be directed.

Current Problem

Assuming that air transportation should be developed to the fullest extent, what are the principal problems with which the government would be faced?

In the first place, a substantial expan





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sion of the present air transport network will be essential. The continued growth of passenger traffic will require many more schedules on existing routes, also numerous route extensions where indicated.

Adoption of a policy to forward the greater part of all non-local first-class mail by air will necessitate a considerable increase in the number of pick-up and delivery routes. To develop fully potential commodity traffic, low cost cargo planes exclusively designed for mail and express will be needed.

Changes in the corporate structure of the industry will depend on the degree to which competition is to be fostered or restricted. The development of the industry through a multiplicity of carriers may prove much more costly to the government than would a more intensive development.

Some degree of competition, however, appears essential to economical and efficient management.

There are a number of disadvantages which appear to be inherent in the method presently employed for determining government payments for transporting airmail. Rates are fixed independently for each carrier by routes and specific schedules, they vary not only among the carriers but also somewhat according to the economic outlook at the moment the decision is made governing those rates.

Fixed rates in an industry so open to change require frequent revision, hence there are numerous and protracted hearings. The setting of rates by rigidly forecasting future revenues is inherently inaccurate in the premises and cannot be easily corrected, particularly if the rates are widely high. Of course, rates can be reduced. But this procedure takes time, and decreases are not usually retroactive.

Rates Vary

Control of passenger and express rates has been left largely in the hands of the airlines, and many inconsistencies have resulted. Yet the rates which the carriers charge the public for other classes of service cannot be dissociated from the problem of fixing airmail rates. The two are alternative methods of affecting gross income and must be made to work harmoniously. Consideration should be given to fixing passenger and express rates at optimum levels consistent with the basic policy for the industry.

In the preceding sections we have considered the nature of air transportation, the elements of growth which it has revealed, its economic characteristics, and its possible expansion (under favorable conditions) within a reasonable future. The realization of these possibilities will depend upon the adoption by the government of a sys-



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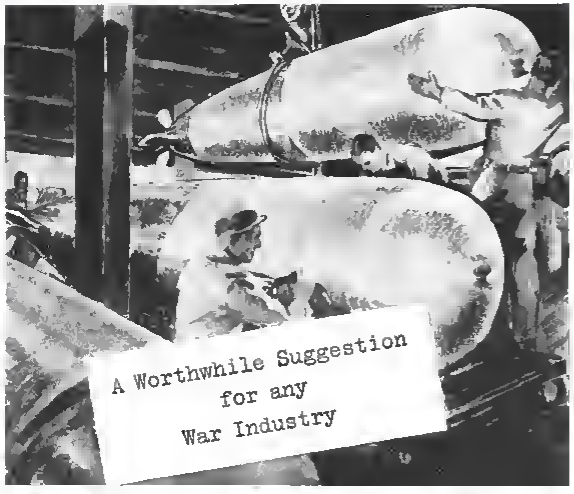
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Frasse subsequently spent a day with the manufacturer's purchasing director, designers, and metallurgists, compiling 'spec' conversion charts and revising prints. 'Spec' checking with Frasse is now a regular process with this war contractor.

Frasse, incidentally, regularly issues identification charts showing up-to-date Government specifications for alloy, stainless and carbon steels—copies are obtainable free from any Frasse office. Meanwhile, why not (1) always mention the effective date of the specification to which you order, (2) keep posted by regularly checking your purchasing records and blueprints with Frasse. *Peter A. Frasse and Co., Inc., Grand Street at Sixth Ave., New York 13, N.Y. (Walker 5-2200) • 3911 Wissahickon Ave., Philadelphia 29, Pa. (Radcliff 7100 - Park 5541) • 50 Exchange Street, Buffalo 3, N.Y. (Washington 2000) • Jersey City, Hartford, Rochester, Syracuse.*



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tematic program to develop domestic and foreign air transportation to its full capabilities, including the forwarding of first-class mail by air wherever it can thereby be expedited; the extension of postal, community, and passenger service to a greatly increased proportion of the important communities in the country, a reduction in passenger and commodity charges; and on other factors.

Notinaol Dafaasa

One inescapable lesson of the war is the tremendous importance of aviation in our national defense program. Pilots, mechanics, transport aircraft, and all the resources of a great civil aviation industry, are now recognized as integral elements in modern defense and offense.

Fundamentally, the most effective peacetime contribution of air commerce is to create and maintain continuously in training the greatest possible reservoir of pilots, mechanics, transport aircraft, and productive facilities. Much of this equipment and personnel, when not actually required for emergency defense purposes, can be most economically and effectively employed in developing the air transportation potentialities outlined in the preceding sections.

Fatura Davalopmant

This is without giving any weight to the additional immense postal and commercial benefits which would result from the intensive development of air transportation. It is possible that the establishment of an integrated national air transport network might lead to mass acceptance of air travel on a scale not yet even remotely approached. It would provide an enlarged commercial rather than primarily a military future for personnel in aviation training. It would encourage the establishment of airports and provide a tremendous impetus to private and other non-scheduled flying at the several thousand communities served by the airlines. It would provide a support for the enlarged manufacturing industry and stimulate the production of improved aircraft, and it would contribute importantly in making our country the greatest air power in the world.

The importance, in the premises of energetically mobilizing the air commerce resources of the United States is obvious to all. No one can foretell, however, what this may ultimately mean in terms of collateral benefits and human relationships. Flying represents a fundamental revision in the ways of mankind, an open sesame to a new world. A transportation policy which did not take this basic fact into consideration would be inexcusably neglectful of the national interest.

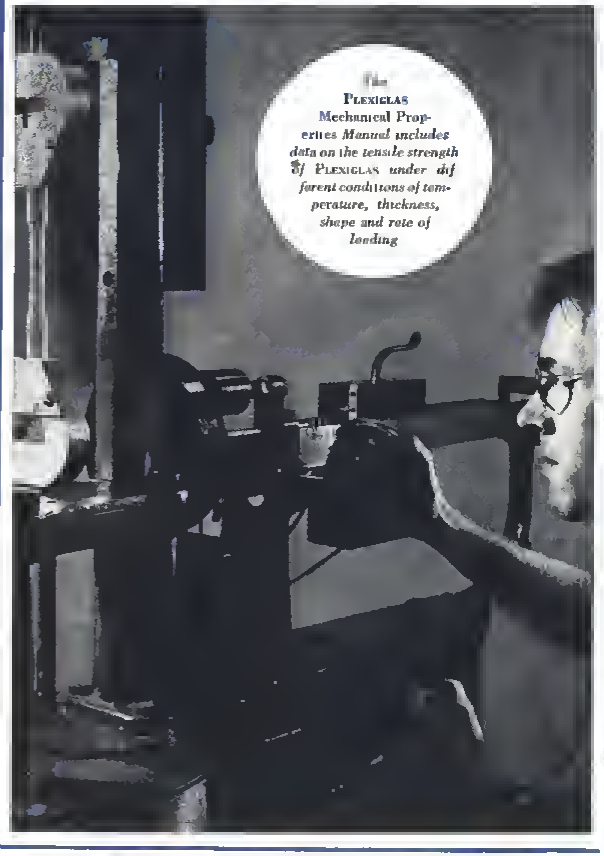
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If Nazis were penguins...

IMAGINE ARMIES of penguins goose stepping all over the South Pole! Heil, Pengler!

But penguins aren't birds of prey. They're just simple fishermen. They'd never yearn for other people's territory. Even if they enjoyed goose-stepping, they'd confine their marching to the Antarctic.

Suppose the situation were reversed. What if penguins were Nazis? They'd certainly become dissatisfied with the South Pole. They'd start "protecting" their neighbors. And after a few peace overtures, they'd attempt a Polar blitzkrieg!

The moral? Just this. You can't make a plunderer out of a penguin, and you can't make a nobleman out of a Nazi. So long as there are Nazis in the world, men cannot be sure of being free.

That's why we must war to the death against the Nazis. In doing so, we must lean heavily on our machine tool industry. We can lean with confidence. This miracle-making industry has overcome Germany's 7-year head start in about a year. And today, for every one machine tool produced by the Nazis, **we are producing 5!**

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Remember that name—Cone Multiple Spindle Automatic Lathe. It will continue to make history after victory is won!

CONE Automatic Machine Company, Inc., Windsor, Vermont

Favoring Factors for Aircraft Investments

(Continued from page 173)

A simple example will demonstrate. Let us assume that an aircraft company earns $10,000,000 before tax payments during a war year and further that its private average (or assumed normal earnings) before taxes were only $4,000,000. Computation of taxes will then take the form indicated in Table I (for purposes of clarity minor details have been omitted). This total tax bill is payable in cash. However, the law specifies that the company will have returned to it 10 percent of the excess profits tax in the form of a bond convertible into cash several years after the war, but convertible nevertheless. In effect this reduces the total tax bill by $540,000 to $6,460,000.

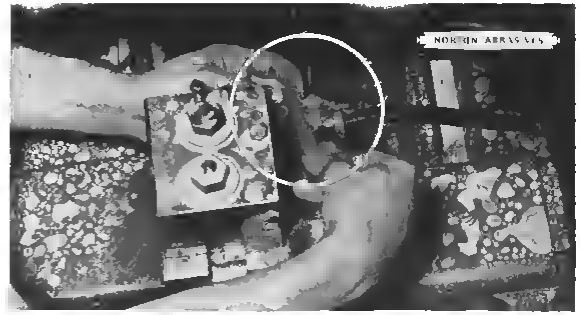
Let us assume further that the war is over and our representative aircraft company during its first "peace" year suffers a loss of about $5,000,000 due to a sharp curtailment in military production, reconversion, and other factors. All is not lost, even so, for a substantial refund is possible through the means of filing an amended tax return. This amended computation would be as shown in Table II.

As a practical matter, in addition to this refund of $4,050,000 there would be a further return of more than $400,000, making for a total refund of about $4,450,000. The complexities of corporation tax provisions accounting for this added amount are quite extensive and need not be detailed here.

It is a fair generalization that the carry back provisions of the 1942 Revenue Act may make it possible for many aircraft companies to cover their losses in a postwar year by anywhere from 40 to 100 percent through tax refunds. Significantly, it is even possible to receive a substantial tax refund even while reporting a moderate profit. For example, assuming that our hypothetical aircraft company should earn about $1,000,000 before taxes in its first "peace" year, instead of losing $5,000,000, then the corporation could properly claim a tax refund of $1,230,000.

These are merely the salient features of the tax law as they may be constructively applied to the aircraft builders. There are various other elements involved and which have alternating benefits and drawbacks. Basically, however, the plan is a good one. As the matter now stands, tax payments assessed on 1941 and 1942 income can be refunded only in 1943 and 1944. There is considerable anticipation that this refund privilege may be extended beyond 1944 and that the same principle will be retained in future tax legislation.

Investment interests are becoming



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Another Case History of Hand Stoning

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Finish cutting Sway Braces, 1025 cast steel, removing .015" stock with ¾" square and rounded 78 B cemented carbide tipped lathe tool bits.

THE RESULTS

1. Increased cutting speed.
2. Four to five times more output between regrinds.
3. Less frequent removal and resetting of bits.
4. Savings in tools, time and expense—fewer grinds.
5. Fewer chipped tools because regularly reconditioned.

IT WAS A WAR SUB-CONTRACT. The cutters had been producing 50 to 60 pieces in about half a day. They were then reground—a slow, expert job to preserve proper rake and clearance angles.

Our man recommended "Crystolon Stones for Carbide Tipped Tools." Using first a medium and then a fine Crystolon stone, the tool bit was touched up by hand after every 35 to 50 pieces. ***This hand stoning was done in less than two minutes without removing tool bit from post.***

Similar savings in expensive alloy tipped tools and in producing and grinding time are possible to thousands of users throughout the country today. Why not have a Behr-Manning Abrasive Engineer or one of the able representatives of our Certified Distributors counsel you on the tremendous advantages of hand stoning? And be sure to ask for a copy of our brand new booklet, "Hand Stoned Cutting Tools."

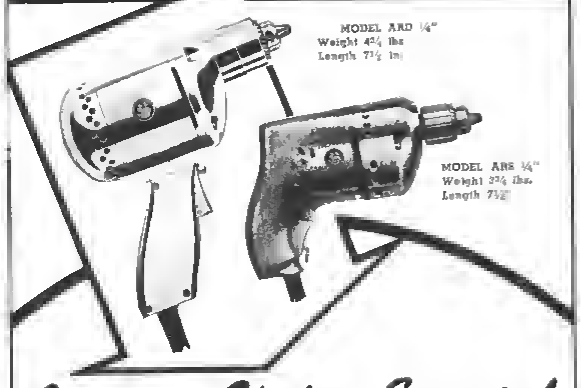
•

Crystolon Stones (silicon carbide) 3½" x ¾" x ½" for Carbide Tipped Tools are available in three grits—coarse, medium and fine, at 50c per stone

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more progress in the advanced future in the way [illegible] the aircraft and quickly situated in dashes. Moreover, with a determined effort now underway to amend the reorganization law so as to permit larger reserves for postwar use out of current earnings, the status of the aircraft builders may be further improved. As developments in this battle in the Department of reorganization before Congress unfolds it is likely market observers will be quick to interpret the possibilities as applied to the aircraft manufacturers.

The unfavorable elements faced by the industry have long been self-evident and have had a tendency to assume exaggerated importance in certain circles. The more favorable factors are now coming to the fore. No longer is unusual apprehension expressed because the aircraft industry has its capital frozen in excess plant capacity. Investment of additional company funds during the war has been very small—if at all.

A leading example will suffice as an illustration. United Aircraft Corp. at the 1940 year-end had a plant investment of [illegible] $17,300,000. As of June 30, 1943 this is reported to about $15,700,000—this in the face of a tremendous increase in the volume of business handled. Actual plant facilities in point of fact increased materially, but they were financed largely by subcharges on French and British billings, together through various arrangements with our own government.

Viewing the position of the aircraft industry in relation to the existing market levels of their securities it is not too difficult to make out an encouraging case for holding aircraft equities.

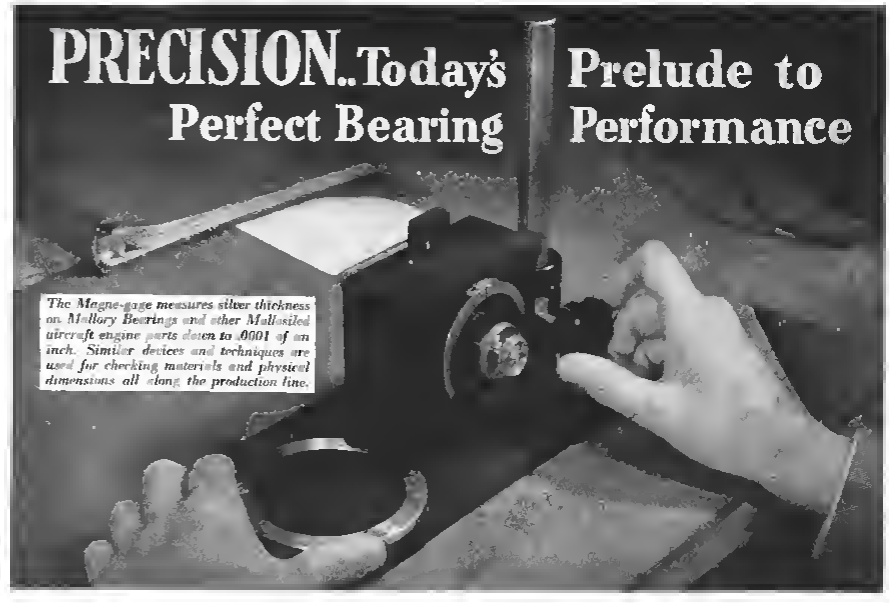
Fighting Line—Abreast

(*Continued from page* 193)

practiced when the section is in the immediate vicinity of enemy aircraft and expects an attack at any moment. In a basic formation the wingmen clear the blind spot behind and below your tail with no danger of collision with your squadron mates. Third when attacked the formation can make a quick turn or "break" to dodge the attacking aircraft easily, and here again there is no chance of collision as long as a large interval is maintained.

To elaborate on this "break" a little. Usually a section will be attacked from behind and above. This means that the enemy aircraft will build up considerable speed in their dive to the attack while the formation attacked will be flying at a high cruising speed. So it can be seen that the attackers will have an airspeed in the vicinity of 100 mph. *greater* than the attacked. It follows from this that the attacked group can

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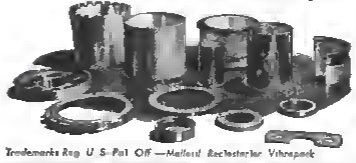


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execute turns more quickly and in a smaller radius than the attackers.

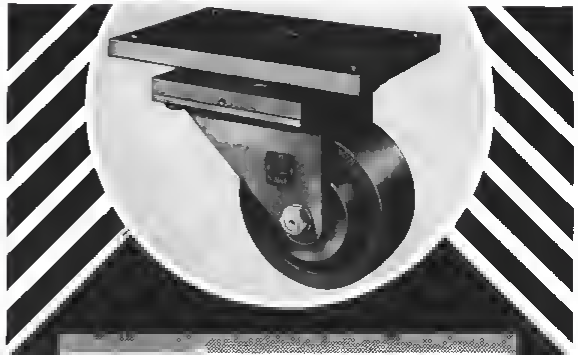
Lower airspeed makes possible quicker and tighter turns. Therefore, when attacked, the formation makes a break—turns quickly as soon as the enemy formation begins to close the range. If the formation makes the break too soon, the enemy will be able to zoom, thus gaining altitude again, and thereupon the enemy dives in once more, utilizing the speed thus built up for another attack. In view of this, the evasive break should not be made until the enemy has *closed* the range to about 1,000 yd. Once the enemy have reached this distance they will be forced to continue the dive, and there is a possibility that the attacked section will be able to make the break and turn back to fire a short burst at the enemy aircraft as they flash by.

Flight Control

Breaks are usually called over the radio by the leader, unless radio silence is being maintained. In normal cases, once contact with the enemy has been established, radio silence, if in force, is lifted. And in most land-based operations radio may be used throughout the flight. If a break is to be made the leader will call the section by the squadron and section call-sign, giving the direction of the break: "Leopard Blue, break right!" In line-abreast, turns are sometimes called so that the pilots won't be caught short and left behind by the section. Here the call would be similar. For a 90 deg. turn the call would be "Leopard Blue, turning half right", in a 180 deg. turn it would be "Leopard Blue, turning left about."

In turns of an odd angle, say 50 deg., the pilots are warned by ground control. For fighters are under rigid ground control from the moment that they are airborne until they land. Radio locaters will plot the incoming raid or sweep, and the section which is in the air to repel the attackers will be constantly informed by radio of the position, height, speed, number, and probable type of the enemy force. The defending fighters will be directed so as to intercept the attackers.

Assume that the formation is flying north, on a course of 0 deg. In order to make contact with the enemy a change of direction of 50 deg. to the right is required. The pilots of the group will hear the ground control fighter director call their leader: "Hello, Leopard Blue leader, vector 50 deg." so before the leader makes his turn the pilots of his section will know what to expect and will have no doubts as to how far the turn is to continue. After visual contact with the enemy has been made, turns will be called and directed by the formation leader, with ground control giving only information of



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immediate value to the airborne fighters.

Area Coverage

In line abreast, all four pilots have a definite area of the sky, relative to the formation, to keep covered. Nos. 2 and 4 look inside, behind, and above. Thus they cover the tail and blind spot of the aircraft next to them. Nos. 1 and 3 look *out* above, and behind, covering the tails of Nos. 2 and 4. If the formation is maintained and the pilots are alert, they cannot be attacked by surprise. If, however, one man lags behind, say No. 2, his tail cannot be visually covered. He is too far behind, hence his leader cannot cover him. (See Fig. 4.)

It has been the practice of some RAF squadrons to scramble five fighters. This is done so that if any one of the five aircraft develops trouble of any kind—radio, engine, oxygen—he may return to base, and the fifth or spare pilot can take his place in the formation. Otherwise if only four fighters were sent up and one forced to return, the effectiveness of the formation, which depends on the utilization of two pairs, would be lost.

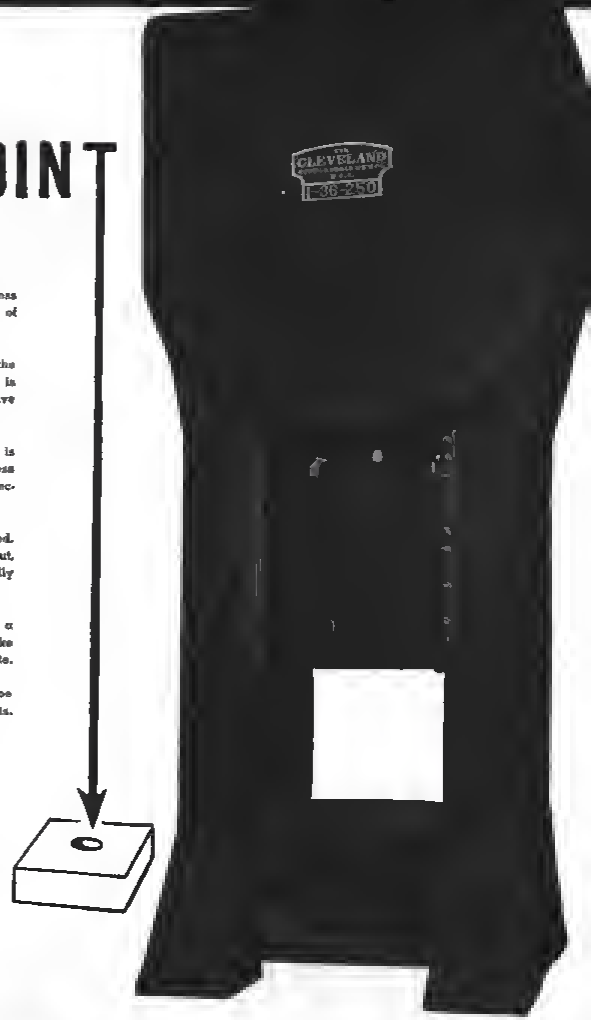
If five fighters are scrambled and no one develops trouble by the time 10,000 ft. has been reached in the climb for altitude and position the fifth pilot returns to base. Four fighters can be handled easily as a section, but experience has proven that any more than four are too unwieldy to operate as a unit. In any case, the fifth man would be like an extra thumb. He would constitute the odd number and the pair system would be broken. If one fighter of a pair is forced to return his wingman should return with him.

If a break is made when the section is attacked, the break should be handled with due regard to the position of the sun and the disposition of all enemy groups in the air area. A section should never be turned quickly to avoid attack in such a direction that, after the break, the section would be flying with the sun and the enemy at their rear. A short aside here. Among combat pilots the sun's relative direction is referred to in terms of "up" and "down". This is similar to the wind references upwind and downwind. If you are flying with the sun on either side of you, you are flying "cross-sun." If the sun is ahead of you, you are living "up sun." If you have the sun behind you, you are going "down-sun."

It can be a fatal error to lead a group down-sun unless you are planning to execute an attack immediately and are in a good position to do so. Formations should be led cross-sun or up sun, unless conditions, such as flying a definite interception course, make it impossible. It's usually a safe rule to

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break up-sun (into the sun), if attacked, then if the enemy fighters attempt to follow you they will be blinded by the sun.

Another factor determining the direction of a break is the location of other enemy formations. If a section is attacked from behind and above ("bounced") and the section leader of the attacked group knows that there is a second enemy formation on his right—then he will break right. If he breaks left he turns the rear of his section to the second enemy group and invites another attack. A general rule for fighter pilots is this: Always turn *toward* the attacking aircraft.

Attack Advantages

When used offensively, line-abreast may be changed into either line-astern or echelon in the attack, or the original formation may be retained. If a single enemy aircraft or ground target is being assaulted, the formation will be changed over to line-astern, one aircraft behind the other, so that each fighter can take a crack at the target in turn.

If a formation of enemy aircraft is the object of the attack and the relative positions of the two formations are favorable, line-abreast will be used throughout the attack.

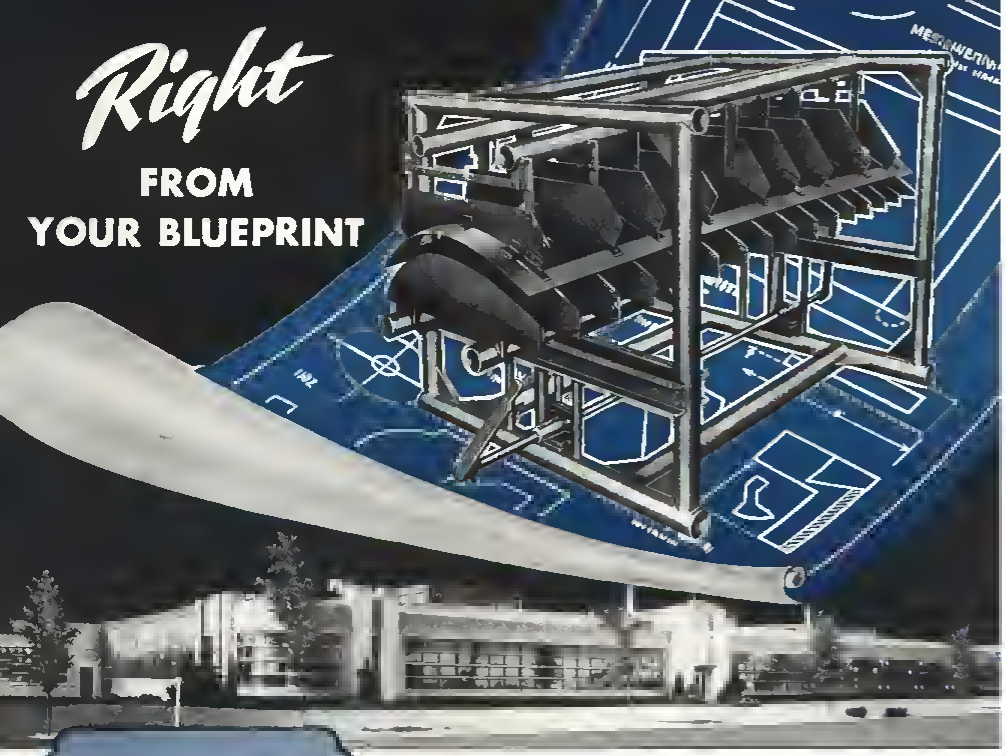
In attacks on bombers with fighter escort the pair system is used. The leader of a pair of attacking fighters goes in to the bombers and does the shooting while his No. 2 man guards his tail. A pilot can't concentrate on aerial gunnery (especially if deflection shooting is used) and be expected to watch his own blind spot to the rear at the same time. It's quite an impossibility.

Many good fighter pilots have been shot down in those few seconds of concentration on the target needed for a successful attack. Reason: Their wingman had been lost and their tails were unguarded.

Lagging behind the formation in line-abreast (in any other fighter formation, for that matter) is sheer suicide if any enemy aircraft are in the area. If there are a group of enemy fighters above your section and you get behind, you have lost the support of your formation mates, your blind spot to the rear is uncovered, and you may be sure the enemy will take advantage of your helplessness and come down on you.

Standing orders in fighter units are: "If you can't keep up with the formation, go home!"

A great deal of the success of the RAF fighter squadrons based on Malta was due to the formation they used. Line-abreast. As the war moves on, this formation is being used more and more. It has proven itself.



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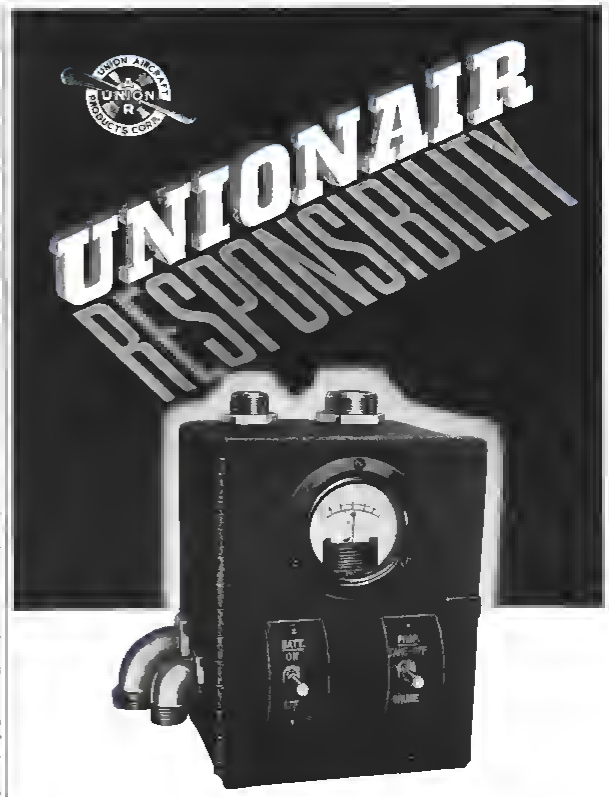


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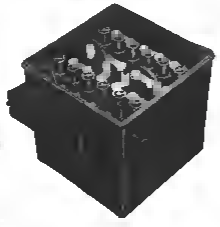


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(Continued from page 116)

that this material frequently must be sold at "a substantial amount below cost." Federal termination officials are told, in many instances, that work in process must and should be sold as scrap. Rarely will delay in disposition of such property result in any substantial saving to the government, and no material should be retained to the hope that at some future date the property will have greater value.

The same policy must apply to obsolete machinery and equipment. In other words, the government plans a grand dumping party to clean its inventory decks after the war. No wonder industry is worried over the astronomical inventories of materials and equipment.

To cover its taxes industry must have cash. Tax reserves are set up to meet tax payments that come due long after the passing of the fiscal year on which they are based. Many companies are forced to make current use of funds represented by these reserves. They then have to depend upon future earnings or liquidation of assets for cash with which to pay taxes.

Some corporate officials feel this is such a hazardous procedure that they refuse to do it. Rather, they restrict current operations if necessary to permit setting aside of cash to meet these payments to Uncle Sam. But can you imagine the aircraft industry curtailing war operations as a means of solving its high unsatisfactory cash position?

Figures of war production required the aircraft makers to use not only tax but also other reserves now currently regardless of the dangerous postwar situation they are creating for themselves.

As shown in the accompanying Chart 2 three representative aircraft manufacturers who have completed 1942 renegotiation had free cash of $299,788,000 at the end of 1941 to meet government taxes and renegotiation payments of $385,744,000. Plus these companies alone had current tax liabilities of $85,954,000 above and beyond their cash resources at that time.

On the other hand, this chart also shows that a similar number of prominent automobile and steel companies had cash of $114,837,000 and $97,237,000, respectively, *in excess of their tax requirements* at the end of 1941.

But what of postwar reserves? The record shows (Chart 3) that these same three aircraft companies had total postwar and contingency reserves of $34,399,000 at the close of 1942 while the three motor car companies had $117,-

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- ☐ Airline Pilot
- ☐ Aircraft or Engine Mechanic
- ☐ Radio Communications
- ☐ Private Pilot
- ☐ Weatherselling
- ☐ Women's Industrial Technician

928,000 and the three steel concerns had $162,548,000.

All the aircraft companies put together had postwar reserves of around $60,000,000 last year. In contrast, United States Steel alone was able to begin setting aside $25,000,000 annually in 1941 to cover reconversion costs. In the first three months—just one quarter—of this year, General Motors set aside $7,600,000 while Chrysler laid by $3,000,000 in postwar reserves.

Donaldson Brown, member of the finance committee of General Motors, told the House Naval Affairs Committee last spring that his company "has no cause to complain about renegotiation." That is understandable to say the least, since both the automobile and steel industries may look forward to peak production of their civilian products when the shooting is over. The longer the war lasts the larger the deferred backlog for steel products and motor cars becomes. In contrast, the aircraft makers may see their current output of around $1,000,000,000 a month slump to less than $500,000,000 a year—half as much production in a year as they have now in just a month.

If the aircraft industry is not allowed to build up postwar reserves worthy of the name before taxes and renegotiation, the truth is that many small concerns may fail and the larger companies will face an exceedingly difficult job of holding their labor organizations together during the critical period after the war.

It should be remembered that employment in the aircraft industry has jumped from 30,000 to 1,600,000 in the last four years and is headed towards a 2,000,000 peak, provided the workers can be found.

If Congress and the administration would allow adequate reserves for this essential industry—in peace as in war—the results would go far toward "helping labor's mood." And management, it might be said, has failed to impress upon labor what this postwar reserve situation means in job security.

Although the book values of aircraft equities have risen rapidly, the ratio of current assets to current liabilities and their cash positions are anything but satisfactory, judged by accepted standards. Wall Street knows this and the American investor knows it.

A glance at the market price of some of the prominent aircraft companies shows that the stock market is so completely unaware of their "prosperity" that their stocks are selling from 3.59 to 1.37 times 1942 earnings, as compared with the usual ratio of selling at ten times earnings. This point is brought out in our accompanying Table I.

What does the average investor think of the aircraft shares these days? A survey of investment dealers throughout the country, recently made by Hugh W. Long & Co. of Jersey City, showed that 64 percent thought the automobile industry had the best postwar prospects while 44 percent agreed that the aircraft manufacturers had the least attractive prospects.

What do some of those in the industry itself think? National Aviation Corp., the largest aviation investment trust and noted for its capable management, decided to make investments in industries *outside* the aviation field for the first time last year. That action, stockholders were told, was taken to "serve the best interests of your corporation." Thus automotive, electric, rubber, and oil stocks are in National's portfolio for the first time, while aviation holdings have been reduced quite substantially.

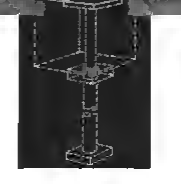
What the stock market is saying about the aircraft stocks in what the standard financial advisory services are constantly reiterating: "These stocks have little attraction at current prices."

This does not mean that the future of aviation is not bright in the postwar years, for everyone knows it is. It means that the industry's problems of readjustment to peacetime production have not begun to be solved. And it means that talk of "excessive" war profits is pretty far-fetched.

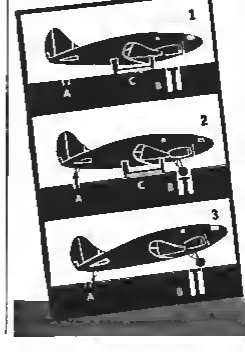
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Platforms "B" are lowered (Fig. 2) to permit landing gear to be extended into pits and locked in landing position. Platform "A" rises to contact tail wheel. Forward platforms "B" now supporting plane's wheels (Fig. 3) are raised to flush floor level, lifting plane clear of cradle, which is then removed. Rear platform is lowered to floor level and plane rolls off the line on its own landing gear.

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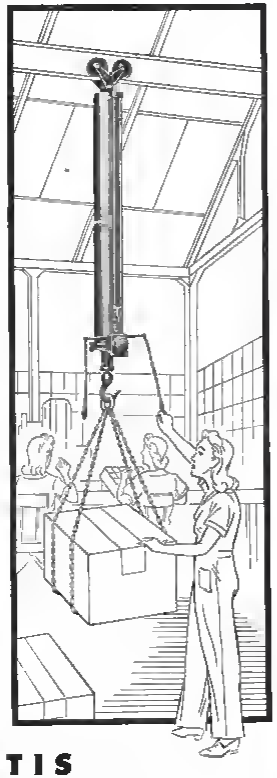
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Long Range Aircraft

(Continued from page 155)

a 1,000-1,200 hp engine, 56 in. for a 1,300-1,500 hp engine, 60 in. for 1,700 hp, and 65 in. for 2,000 hp.

Furthermore, tip floats have been supposed retracted inside the engine nacelles, with the effect of Reynolds number compensated for any increase of drag generally allowed for interference and irregularities. Hence the drag data in our Table III.

Values thus obtained (and as tabulated in column 8 of Table III) have been plotted vs. the corresponding values of total bhp on Fig. 4. The points such as *A*, *B* and *C* (where the dotted curves, joining whichever of these values pertain to the same value of wing area, intersect the first and corresponding curves of bhp vs. minimum parasite drag) represent the solutions which can actually be obtained through this study's numerical value technique.

It is then possible to draw the locus of such points as a curve of minimum parasite drag (actually obtainable) vs. wing area, as shown in Fig. 5. It should be remembered that for each point taken on this curve, the aspect ratio, the maximum required bhp, as well as the load of fuel necessary for the crossing, are predetermined by the preceding diagrams, in order to satisfy the system of equations imposed by the problem.

The next step consists, we know, in estimating the weight quantity $W_s + W_f$ for the various combinations of characteristics defined by that locus of solutions. This has been done using the empirical Weight Formula 5 mentioned previously, the successive steps of the computation being given in Table IV.

For the sake of simplifying the computation, we have assumed that the geometrical aspect ratio considered in the estimation of the structural weight was equal to the virtual aspect ratio R_v. For an accurate evaluation of that weight, it would be necessary to consider the geometrical aspect ratio as equal to

$$\frac{R_v}{e}$$

e being the airplane efficiency given by empirical curves as function of R_v and C_{p_0}. Curves drawn from these results on Fig. 6 show, finally, the variation of that part of the plane's variable weight is mostly a wing area function.

Optimum value is found to correspond to a wing area of 3,575 sq. ft. However, since we shall consider the solution closest to this which can be built around existing engines, we shall choose 3,560 sq. ft. which, according to curves 3 and 4, corresponds to 8,000 hp., or four engines of 2,000 bhp. each.

Of course, it is advisable, when doing this, to choose a wing area value slightly



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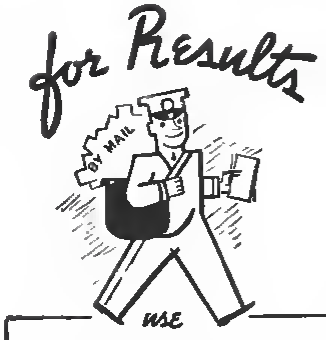
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under, rather than slightly over, the area of minimum weight, since this is advantageous both from the point of view of safety (because of a lower value of power loading) and because of increase in performance, since the average cruising speed would be higher.

In this case, and assuming a takeoff power of 2,200 hp. per engine, the basic characteristics would be—

Wing loading,

$$\frac{150{,}000}{3{,}560} = 42 \text{ lb. per sq. ft}$$

Power loading at takeoff·

$$\frac{150{,}000}{8{,}800} = 17 \text{ lb per hp.}$$

Average cruising speed V_c (True airspeed at sea level.) is 128 mph

Necessary fuel load $W_f = 56{,}000$ lb with also

$$R. = 9.2$$

$$C_{p_o} = .0269 \quad C_{D_o} = .054 \quad C_{L_c} = .88$$

$$\text{Max. } L/D = \frac{.88}{.054} = 16.3$$

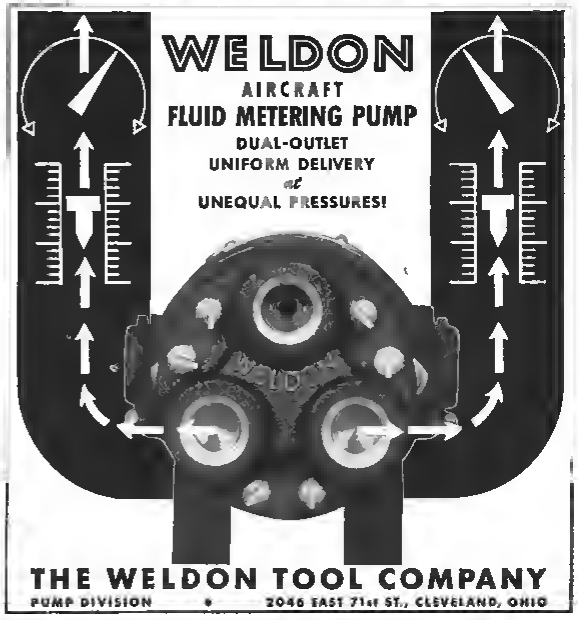
From Equations 3 and 6 we may now obtain the variation of optimum airspeed (speed at max. L/D) with the plane gross weight, at sea-level, 5,000 and 10,000 ft., as well as the variation at the same altitudes, of the required brake horsepower. (See Fig. 7.)

As for fuel economy, we know that the average specific consumption of .42 which we have adopted will be realized with modern engines only as long as they are used between certain limits of the ratios of their total rated power —let us say, for example, between 40 and 55 percent. We can deduct from such curves "advisable zones" of utilization in power and altitude, as shown in shadowed portions of diagram

Thus, we see that it would be advisable to start the flight at low level and finish it at high altitude. This is all the more true, since less fuel will be required to climb to the higher altitudes when the gross weight of the plane has been reduced by partial consumption of the fuel load. The operator may, of course, be obliged, on account of the wind and other meteorological conditions, to choose another altitude than that recommended. Such diagrams, which should be also extended to different wind conditions, are nevertheless useful since they may enable him to analyze all the possibilities of plane and power plant adaption.

As we have assumed, conservatively, that the plane was constantly flown at the optimum airspeed for calm air, irrespective of wind component, we now give a more precise method for performances in respect to wind.

Reconsidering Range Formula 1 (Part I) we can easily see that if the speed V is a variable to be chosen as function of the wind component w, the maximum range will be obtained on





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longer when flying at max. L/D but at an angle of attack so product of

$$L/D \times \frac{t - v}{i}$$

a maximum, considering that

$$C_D = C_{D_i} + C_{p_i}$$

and since C_{p_i}, the induced drag coefficient, is equal to

$$\frac{C_L^2}{\pi R},$$ then—

$$C_D = \frac{C_L^2}{\pi R_i} + C_{p_i}$$ and

$$\frac{L}{D} = \frac{C_L}{C_D} = \frac{\pi R_i}{C_L} + \frac{C_L}{C_{p_i}}$$

We thus have to find the maximum of the quantity

$$Q = \frac{\pi R_i}{C_L} + \frac{C_L}{C_{p_i}} \qquad \frac{t \pm i}{V} \text{ where}$$

$$V = \sqrt{\frac{300\ W}{S\ C_L}}$$

This can easily be done by drawing the curves $Q = f(C_L)$ for a certain number of values chosen for v, such as ± 10, ± 20, ± 30, etc.

Applying this method to the preceding example, we find that the optimum values of C_L, for the plane at full gross weight, are .8, .7, and .6, respectively, for wind components of -10, -20, and -30 knots (instead of 88 found in the case of calm air). Repeating this for a certain number of gross weights will make it possible to draw all the corresponding required power curves.

Although the application of the proposed method to the example under consideration has been somewhat over simplified and would in actual practice require considerable more care (especially in the evaluation of the minimum parasite drag as well as of the structural weight of the different solutions) the results give interesting deductions.

One of the main lessons is how illusory it now appears to attempt to estimate the influence of certain fundamental factors, such as wing loading and aspect ratio, on the operational characteristics of a design. Within the limits of a satisfactory solution for a long-range design, these factors appear closely related and should not be considered independent variables.

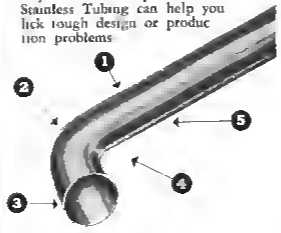
Furthermore, from the point of view of payload analysis, it is not only their influence on aerodynamic performances which counts but also on structural weight and fuel load needed.

All that can be said about this apparently, is that within the relatively close and usual limits of the coefficient C_{p_i}, Fig. 3 shows that the optimum aspect ratio will be as much smaller, as the wing loading, and therefore the speed, are higher.

What is most clearly demonstrated is the outstanding importance of the parameter C_{p_i} and the very definite advantage, from whatever point of view we consider the projected design of reduc-

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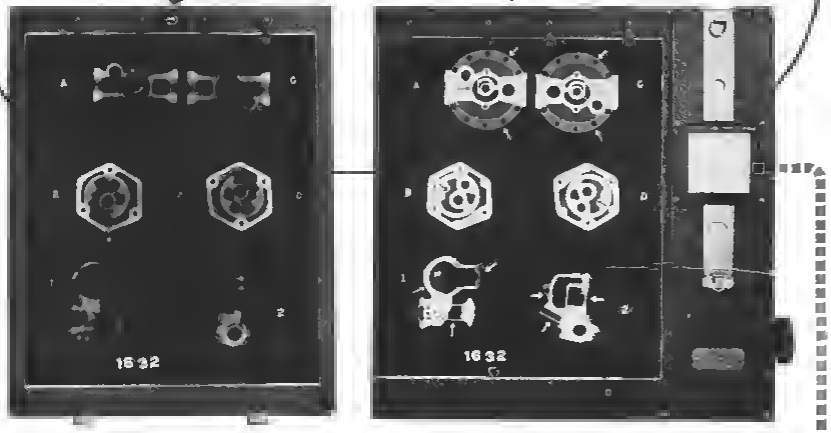
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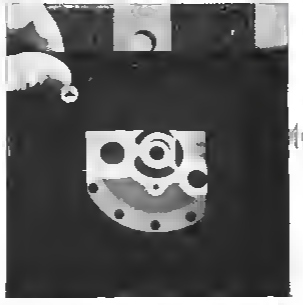
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ing this coefficient to its minimum possible value.

From a careful analysis of Figs. 1 to 4, it appears indeed that both the structural weight and the necessary fuel load are being reduced because lower values of C_{D_0} permit solution of the problem with less aspect ratio and less power. The speed—although this is not a primary consideration—also varies in the right direction.

Of course, if the speed were of primary consideration the solution would be quite different; then a higher wing loading and lower aspect ratio would be desirable.

From the point of view of sound economic operation it therefore appears that some sort of compromise is necessary between the two solutions—of increased fuel load, on the one hand, and of increased structural weight (due to larger wing area and aspect ratio) on the other.

The criterion of value for such a compromise would consist precisely in finding such a wing size and shape that the total power required for takeoff be used at its best efficiency in long range cruising. And that, of course, has been the main object of this study.

Before closing it, however, we wish to discuss a few points which frequently seem to be confusing, viz., the altitude effect and the optimum number of engines.

The first of these can best be understood if we remember that maximum range or maximum payload on a given flight are, in the last analysis, essentially a function of the average mileage obtained per unit load of fuel burned, a ratio which can be expressed:

$$\frac{V_c}{BHP._c \times c}$$

(BHP. referring to the average value of power used in cruising).

Considering first the case of calm air, and disregarding also for the time being any altitude influence on the over-all power plant efficiency, it can easily be shown that the above ratio will not be affected by variation in the specific property of altitude, which is air density. Whatever the altitude, the plane will indeed be flown at a constant angle of attack (for best L/D) or, other things being equal, at constant indicated airspeed:

$$V = V_c \times \sqrt{\frac{\rho_0}{\rho}}$$

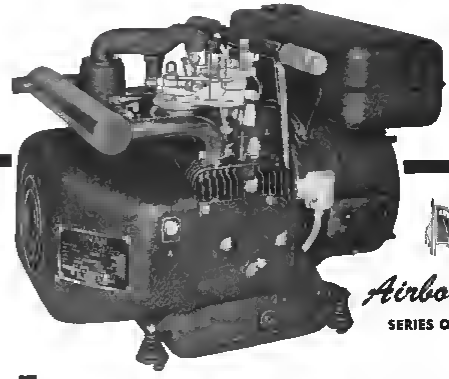
and since, from Equation 3,

$$BHP._c = K \times V_c^3 \times \sqrt{\frac{\rho_0}{\rho}}$$

where K is a constant, the ratio of those quantities will not depend on the density factor

$$\sqrt{\frac{\rho_0}{\rho}}$$

that is, on the altitude



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In other words, and contrary to what is too often believed to be the case, the reduction in air density accompanying an increase in altitude, should not in any way modify the maximum range or the maximum payload of a plane flying a given route. Under the conditions specified above, the plane will fly faster but will also burn more fuel, and the mileage per unit of fuel consumed will thus remain unchanged.

Therefore we may say that, with the same load of fuel, in long range cruising, a plane will fly faster, in proportion to the altitude factor

$$\sqrt{\frac{\rho_0}{\rho}}$$

but will not fly farther.

On the other hand, there are two other factors which may influence the range performance at altitude. The resulting variations in the over-all power plant efficiency, and meteorological conditions.

As to the power plant, altitude may effect the range through a variation of the ratio

$$\frac{\eta}{c}$$

of the propeller efficiency to the specific fuel consumption.

As we have already pointed out in reference to the curves of Fig. 7, when cruising at best L/D there is always an optimum altitude at which the power required can furnish the best value for this important power plant factor. But this continuous change in altitude recommended in proportion to the reduction in gross weight, other things remaining equal, is something quite different from comparing two flights made constantly at two different altitude levels. Here it is the mean values of the ratio

$$\frac{\eta}{c}$$

pertaining to each flight which must be compared, and in that respect, experience shows that with present aircraft engine characteristics, there is not much to gain by flying at a higher altitude.

As a matter of fact, any favorable tendencies which might be expected in that direction, seem to be more than offset by several factors which intervene. The excess fuel consumption inherent in any climb, the tendency—not yet well defined—to a certain increase in specific fuel consumption with altitude, and the loss of the power required to drive any mechanical supercharger above critical altitude. Actually, from the point of view of powerplant over-all efficiency, the net result of flying constantly at higher altitude is an appreciable drop in the average mileage per unit of fuel consumed, thus a reduction in maximum range or payload. However, it is not impossible that in the

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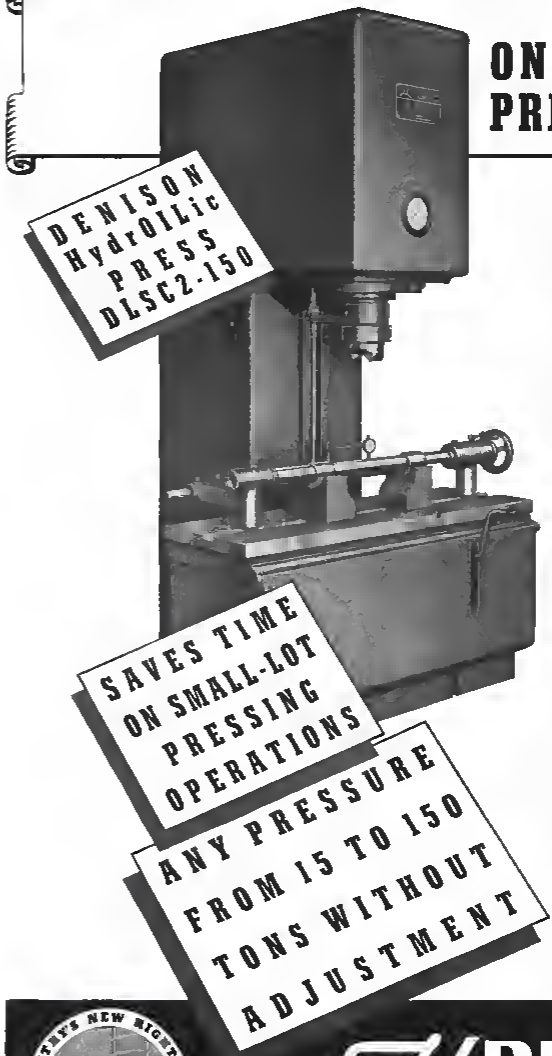
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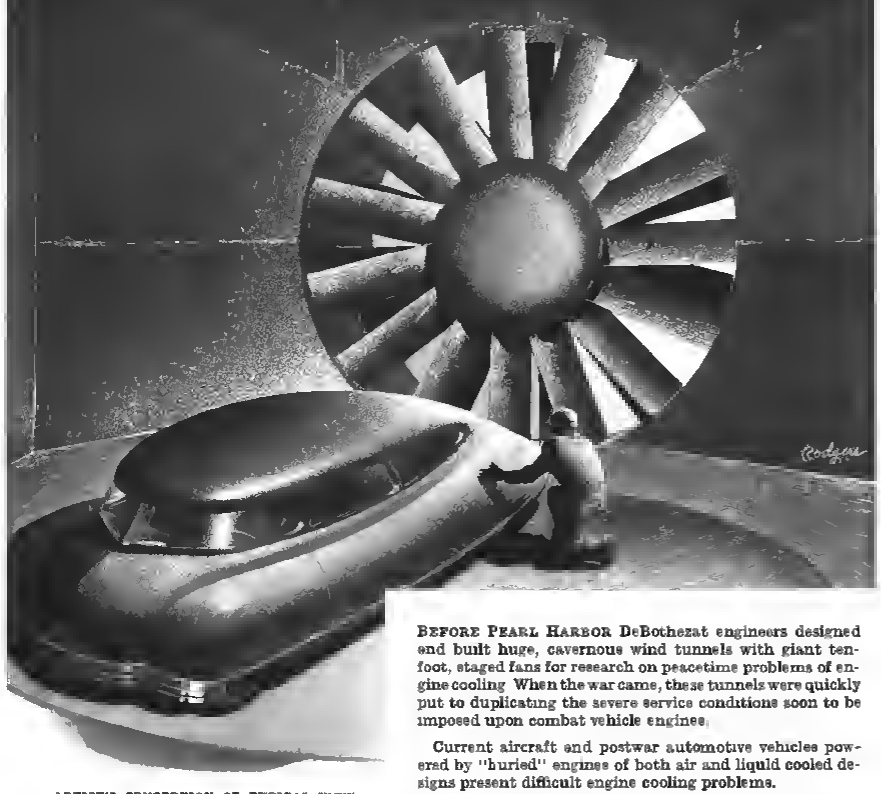
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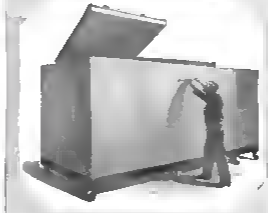
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near future, the introduction of turbo-superchargers into more general usage will modify these conclusions.

There remains the question of altitude effect due to the corresponding change in wind intensity. We have seen that the wind component v entered the range formula through the expressions

$$\frac{V \pm v}{V} \text{ or } \frac{V \pm v}{BHP. \times C}$$

Both of these show that the higher the cruising speed V, the less a constant wind v will affect the range. If, therefore, the wind was remaining constant with altitude, it would be advantageous to fly high.

Actually, except for occasional meteorological conditions, the wind component usually increases with altitude up to the stratosphere, within the altitude limits of present flights it thus becomes generally advantageous to fly high with a tailwind and fly low with a headwind.

To be more specific, we can express by

$$V \times \sqrt{\frac{\rho_1}{\rho}}$$

the head-wind component at altitude which at an altitude of density ρ would be equivalent to a headwind component v at sea level, qualifying equivalent meaning in this case that it would not impair the corresponding sea level range and payload values. Such being the case, the ratio

$$\frac{V - v}{v}$$

would remain unchanged. However, as the wind intensity usually increases with altitude at a higher rate than

$$\sqrt{\frac{\rho_1}{\rho}}$$

except as in the aforementioned exceptional cases, an increase in altitude will generally be unfavorable to long range flight into a headwind.

To sum up, the only benefits which could be generally expected from increasing the average altitude of a long range flight, are a definite higher cruising air speed in any wind and a certain improvement in range or payload if the plane thereby benefits from a more favorable tailwind.

As to the optimum number of engines, we shall first examine, in the numerical example, the difference in payload between the optimum four 2,000 hp. engine solution and the one, with six engines, nearest approaching it, which would be of 1,500 hp. each. This can be measured by the difference between the two weight values $W_1 + W_7$ of each case, as given by curve 6, and is relatively small, since equal to 96,300 – 95,200 = 1,100 lb.

Of course, the simplified view we have taken of these evaluations may not correspond exactly with the facts, in that the unit weight u, which has been



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assumed constant, could really be somewhat lower for the larger engines

On the other hand, in the estimation of the minimum parasite drag, which conditions among other things the fuel load W_f, we have admitted that the variation in drag due to the different engine installations, was simply a function of the diameter of the nacelles. We did not take into consideration that part of the drag variation due to the interaction effects of different nacelles with the part of the wings adjacent to them. Since some tests have shown that this interaction can have appreciable effects, it is conceivable—although a great deal depends on the relative thickness of the wing and the engine nacelle diameter—that the six engine arrangement may not present as great an increase over the four-engine arrangement as has been generally admitted.

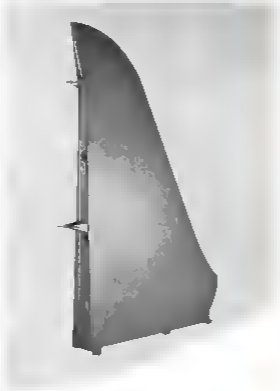
In any case, any such increase will disappear or be greatly reduced the day—not so far away—when the wing will be thick enough to house the power plants more or less completely. Therefore, the variation in weight and drag, presented by a given type of plane when equipped with a varying number of engines, would furnish an interesting and worthwhile subject of study. This is the more evident if we notice that, in the case of our numerical example for instance, a six-engine solution could present over the corresponding four-engine solution a number of real advantages which should not be overlooked.

There would be first an appreciable improvement from the point of view of safety, as, in the case of an engine failure during takeoff, the total available power would be affected by only one-sixth of the original amount instead of by one-fourth. Also it would be found that the requirement of maintaining a minimum rate of climb of 300 fpm with only 70 percent of the total rated bhp could be met by using only 84 percent of the rated power for the six engines, as against 93 percent, or almost full throttle, for the four-engine plane. Moreover, this does not take into consideration the fact that the climb characteristic would be much less affected in the first case since the dissymmetrical attitude of flight resulting from a feathered engine would certainly be much less marked.

Another advantage of the same nature would be apparent if, in the process of a long range flight, the plane had to continue for an appreciable length of time with one inoperative engine.

Again, the excess of fuel required for such an eventuality, and taken on board before departure to the detriment of the payload, would certainly be less in the case of a six-engine plan.

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solution is the possibility of making better use of the total power by stopping two out of the six engines, the symmetrical condition of flight remaining unimpaired, whenever the power required from all engines to hold the best speed at L/D is so reduced as to be inefficient from the point of view of the power plant factor

$$\frac{v}{c}$$

In fact this procedure was a common practice after 28 hr. of flight on the old six-engine flying boat used by the French Airline to survey the North Atlantic in the years preceding the present war.

It was this experience together with the advantage of increased safety at takeoff which constituted the main arguments in favor of the six-engine solution retained for the more modern 40- and 70-ton boats built subsequently in France for the same services.

Considering as secondary advantages that the slipstream effect which intersects a larger part of the wing area on the six-engine plane is a favorable factor improving takeoff performances, and that the greater couple produced by the outboard engines would offer better maneuverability on the water, we can recognize that four engines, however possible, are not necessarily preferable—as the present trend would indicate—to a larger number.

Future Trends

Therefore we are of the opinion that whenever it will not produce an exaggerated increase in structural weight and minimum parasite drag, we shall witness, especially for the larger machines of the future, a definite multiplication of the number of power plants.

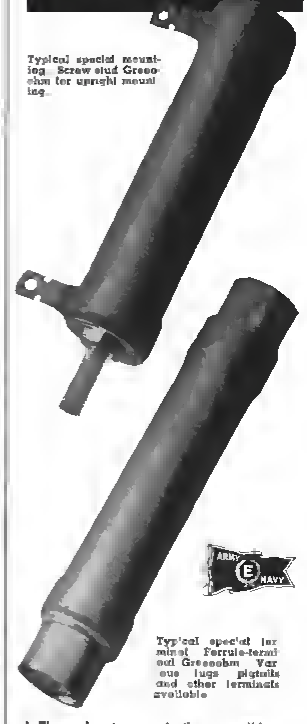
Such, in our estimation, are the main considerations pertaining to the optimum solution of a long range airplane design. As we have seen, they are constantly related to the determining factors imposed by a given type of operation.

Although they reveal the complexity of the problem, they also indicate that with sound cooperation between operation and construction (the two engineering parties involved) a scientific solution can be arrived at in which the errors of personal judgment and compromise will have been reduced to a minimum.

This is the indispensable condition of success, also a fair guaranty of closing the gap which has too long existed between aeronautical expectations and their realizations.

Editor's Note: The opinions expressed in this article are those of the author and are not to be considered as those of American Export Air Lines.

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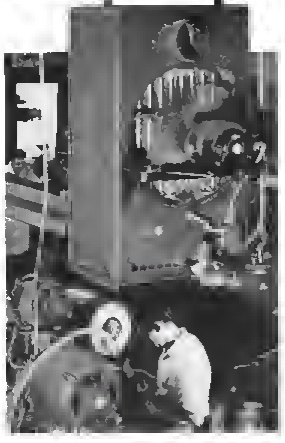
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America at War

(Continued from page 117)

aarta of world air transport. The highest government officials, including the President, will take a hand in the inevitable controversy over domestic and international air rights. And because the United States is a world leader, other governments will notice what is done and will try to influence our action.

The main bout will be between the Executive and the Congress. Some weeks ago a group of Senators took note of quiet efforts of the Administration to make a bilateral air transport deal with Britain. Sen. Champ Clark thereupon called upon the President and other officials and made it clear that Congress intends to sit in on the planning of the postwar aviation world.

Aircraft manufacturers still are not satisfied with the contract renegotiation law, under which the government recaptures any profits which are considered "excessive" by Army and Navy price adjustment boards. The manufacturers say they do not wish to profit by the war, but they do want to be allowed to accumulate cash reserves with which to rehabilitate themselves and their employees after the war. Congress has turned down several attempts to revise the law, even for industries whose futures are more precarious than aircraft, and the outlook is not bright for the current attempt. However, these matters are unpredictable because the temper of the people changes as the war passes into new phases.

Contract termination may also call for Congressional action. After the last war, quibbling over settlement of many war contracts went on for months and even years. This time, war manufacturers want a system which will enable them to get out clean in order to put their energies to a new beginning. Many of them say they would rather take a moderate trimming from the government and get out quick than fool around indefinitely. Some government contract executives feel that War, Navy, and other procurement agencies should risk losses to attain speed.

The Army has already terminated some 5,000 contracts, and the Navy about 1,500. This comprises "good practice" for the big close-out events yet to come. And, incidentally, this war is so much bigger than the 1914-18 job—in terms of materials—that cutbacks already add up to more than total contracts terminated in the post-armistice days of 1918.

It is doubtful if any high and responsible official in the government has made up his mind just what should be done with the war plants, and how. This problem is enough to send all the economists from Harvard to a boogie woogie session. But Congress will have to deal

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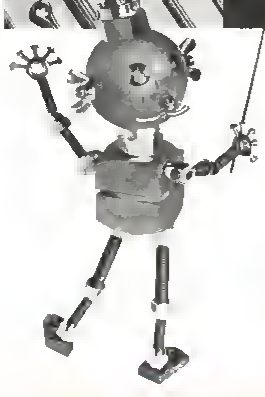
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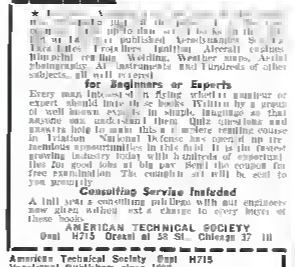
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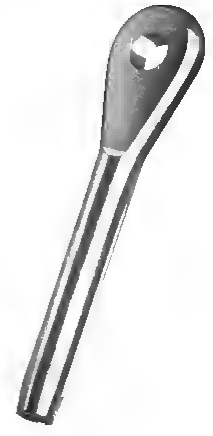
with it—as will [illegible] all the fast political and [illegible] schemes that will come in its wake. The public will never quite understand what goes on. You may look for said public to approve of whatever schemes are most simply presented, and which seem to pay off in some form or other. This is a free enterprise deal. About one-fifth of the industrial power of the United States is now owned by the government—and a big slice of it is airplane factories. Responsible authorities, both private and official, have estimated the postwar requirement for aircraft at from 10 percent down to 1 percent of the present output—implying that most of our plants will have to make something other than airplanes, if they make anything.

As stated, on the battle fronts all goes favorably at this writing. During recent months the AAF command could hardly believe in the comparative weakness of the German Luftwaffe. Even Under-Secretary of War Patterson thought that Goering might have stored some aviation up his sleeve for a last ditch fight. But now it is clear to all that the vaunted air machine which once threatened the world with its power and its banshee whistles is not what it used to be. It can still fight valiantly in defense of its strongholds. But it cannot muster enough power from its three-sided front to make an attack in force. Probably any one of Germany's three enemies is now superior to her in point of aviation. The USAAF estimates that Germany has around 5,000 combat planes capable of action on any given day (with 5,000 in reserve). The Russians say that 3,000 of those planes are on the eastern front leaving 2,000 to face the western and southern fronts.

The effect of bombing is a sort of creeping paralysis. It hasn't yet crept from Germany's manufacturing centers to the fighting arms. When it does, the Allied command will feel more certain whether or not it wants to take any long steps toward purely strategic action. It is reasonably safe that Russia is taking the brunt of the war. That certainly is true in terms of lives sacrificed. But history may show that Allied attrition delivered the punch that glazed the monster's eyes and sagged his knees.

We are getting a first view of aviation limitations in this war. When we passed the President's 50,000-plane goal, many persons wondered whether we could run the figure on up *ad infinitum*. When the British staged a 1,000-plane attack on Europe, many wondered if the scale could be stepped up to several thousand. The answer is now clear to see. If we run full-scale land and sea wars, we can manage only a limited amount of air war. We were busting our suspenders passing the 50,000 plane mark, and regular 1,-

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000 plane assaults are still in the future.

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Our fleet of aircraft carriers is surprisingly large now and is growing rapidly. There have been indications lately that we may be able to hit Japan hard with ship-based aviation in addition to our land based campaign, which will continue to be a struggle. Recent offensive actions by our fleet in dangerous waters comparatively close to Tokyo tend to show that ship-based attacks will be practical as soon as we have the necessary fleet superiority. Meanwhile, there is always the chance that the Japanese fleet can be caught and decimated in a show-down battle.

Some estimates of Japan's aircraft output now ran as high as 1,000 per month. But whether it's 500 or 1,500 won't save the Nipponese when England and the United States join forces against them. Japan is showing a serious lack of elasticity in airplane design. The improvements come slowly and none of them shows true facility in the military competition.

Germany's war leaders know now that they are licked. They are only hoping that time will wear us down, thus enabling them to negotiate for their necks and their original domain. The average Jap, on the other hand, considers himself farther removed, sitting out of range on a vast empire which, as yet, has hardly been scratched.

Refrigerators to "Thunderbolt" Wings

(*Continued from page 147*)

ing department. Among its duties are: To obtain drawing changes when necessary, determine which parts are to have blank holes, establish blank sizes for skins, assist the dispatching department in obtaining the most effective flow of material, develop methods for efficient storage of parts, obtain tools when required, have tools repaired and rede-

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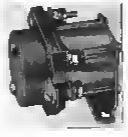
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AVAILABLE in Models 15 and 30 Hand Extinguishers, Models 150 and 350 Wheeled Extinguishers.

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It retains the long-range effectiveness of the stream which permits the operator to knock down fire from a greater distance. It hangs in a cloud over the fire, providing greater smothering action and reducing flash-backs. Like the former duGas, PLUS-FIFTY duGas will not cake, harden, evaporate, deteriorate or freeze. It generates no toxic fumes and is not an electrical conductor. Since no critical materials are used in its

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Chart showing characteristics of *all* types of approved hand fire extinguishers.

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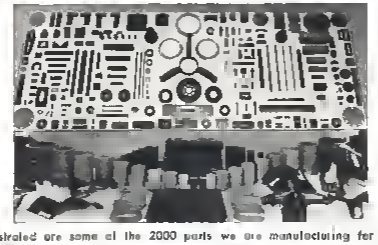
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Illustrated are some of the 2000 parts we are manufacturing for the aviation industry. PANELYTE parts are used, also, by the Navy, Signal Corps and Direct Service Procurement

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...of all necessary, and in addition maintain all records required to obtain desired changes or adjust operative trouble.

In addition first trouble shooters encourage refinement in design, improve production methods, assist in forecasts, and schedule material flow. The result of their activities is that the company is turning out wing sections decidedly ahead of contract time, with less rework and fewer inspection difficulties than expected.

After final assembly on the main jigs, wing sections proceed on dollies to the installation of wing tips, ammunition and gun bay doors. Traveling on the same dollies, they are painted, insignia is stenciled, the landing gear is installed and then the wing sections are pit tested on a hydraulic fixture of company design to see that landing gears are mounted to clear properly. There follows final inspection and acceptance by AAF prior to shipment.

Douglas Licks U-Boats

(*Continued from page* 142)

The assembled section is then moved on the same dollies to a reserve area adjacent to the final assembly line.

The center wing section, removed from its dollies and attached to others in flight position, is rolled into the first position of the final assembly line. There the fuselage, still on the carriers on which it left the final fuselage line, is lifted by traveler crane and lowered onto the center wing section. The tail stub is then attached and further joining operations are completed in the second and third positions.

Installation of the empennage is next completed, and in the seventh position the ship is raised for installation of the main landing gear. Wing-to-fuselage fillets and fuel tank covers are installed in this position.

For the next four positions the main cabin and cargo floors, oil coolers and the glider towing equipment are installed, followed by empennage control rigging, installation of engine tail pipes, and miscellaneous firewall equipment before hanging the engines, the next operation.

Engine hook-up and engine control rigging requires three positions, and installation of center wing compression ribs, pilot's seats, and hydraulic tests, including landing gear operations, are completed in three more.

In the last three positions of the first leg of the line, engine cowlings and propellers are installed, and the propeller controls are hooked up. Then the plane moves forward, on its wheels to one of two reserve positions at the head of the final leg of the line. There the wheels are run onto carriers which run on one rail and a steel plate, with another carrier running on the concrete floor under the tail wheel. These carry the plane at a 30-deg. angle (to conserve space) as outer wing panels are attached in the first working position.

Hanging the outer wing panels, rigging the flaps and ailerons, and installation of batteries require two positions while completion and testing of electrical and radio equipment and a check of the automatic pilot occupy two more.

The company's inspection is accomplished next and is followed by squawk corrections, pick-up work, and final inspection. Army inspection and pickup take two positions more, and final camouflage paint operations are completed in the last station of the line. After moving out of the plant, field operations are performed on the flight ramp, then the plane is ready for flight tests.

Late in the week of Aug. 15-21, the 2,000th C-47 version of the DC-3, rolled from these lines. Exactly how many more than that have been produced since Pearl Harbor cannot be revealed, nor can the actual count of those on order, but whatever the current or eventual total, they will be coming from one of the most completely mechanized assembly systems in the world.

AIRCRAFT PLYWOOD



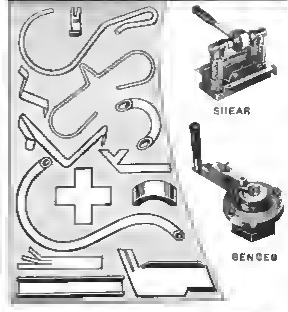
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(Continued from page 206)

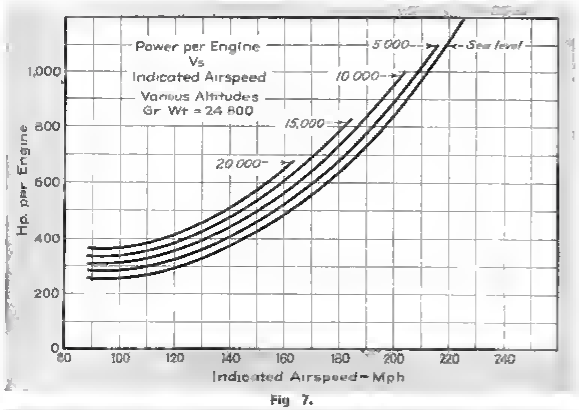


Fig 7.

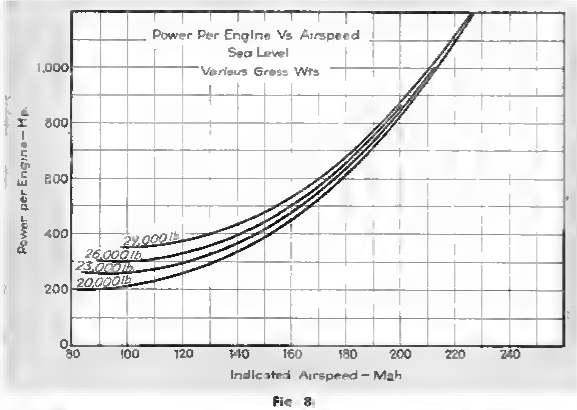


Fig 8.

speed, as in Fig 7 Note The data can be replotted in another way (Fig 9) taking values from Fig 7 by, for example, noting the indicated airspeed at each altitude which results from 600 hp per engine and correcting for installation to obtain instrument airspeed

This is repeated for as many powers as desired, and thus, for the standard weight chosen, the instrument airspeed for any altitude and power is known It is noticed that the values of true airspeed for any altitude are also drawn on this chart. Thus in effect, the power lines are superimposed on the airspeed correction chart shown in Fig. 4.

There is now only one more correction to make, that correction being for weight A process similar to that shown in Table I is now used to determine the effects of weight variation

The table is for sea level density Standard weight in the P_{1w} versus V_{1w} curve of Fig 5 is 24,800 lb.

Again at sea level, 24,800 lb, we find that V = 89 mph and P = 268 hp at 20,000 lb —

$$W_R = \frac{W \text{ (actual)}}{W \text{ (standard)}} = \frac{20,000}{24,800} =$$

$$W_R^{1/2} = .898 \quad W_R^{3/2} = .724$$

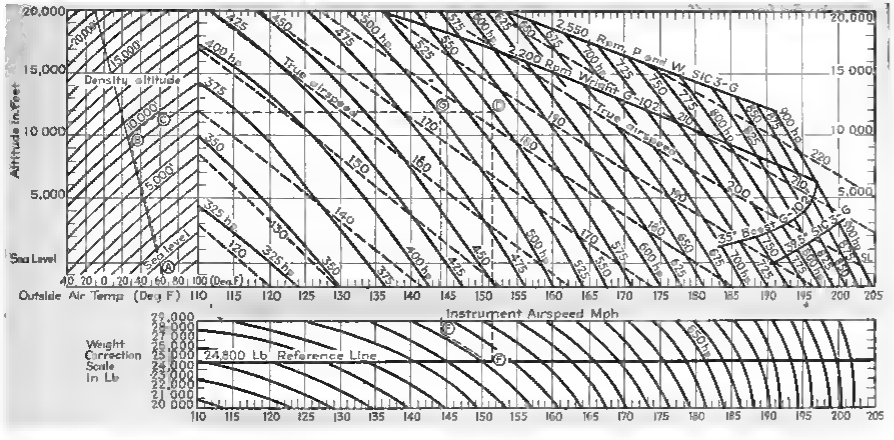
thus at 20,000 lb —

$V = 1_w (W_R^{1/2}) = 89 \times .898 = 82$ mph

$P = P_{1w} (W_R^{3/2}) = 268 \times .724 = 275$ hp

In like manner, the values of $W_R^{1/2}$ and $W_R^{3/2}$ are determined for the gross weights to be considered, and the corresponding values of P_{1w} and V_{1w} are

Below, Figs. 9 (top) 10 (bottom) Instrument airspeed chart for any power and altitude, combined with weight correction scale showing change of instrument airspeed at constant power and altitude for constant horsepower





GRAND CENTRAL AIRPORT

We read of mock-ups of planes designed to carry more passengers than a streamlined train We hear of a mammoth dam being built in the frozen north—all materials and men transported by air. We hear of so many soldiers being transported so far in so many planes The complete facts are military and corporation secrets. But one fact is plain:

As new planes are designed and built, more and more OSTUCO seamless steel tubing is required—for engine mounts, fuel lines, shaft and door assemblies, fuselage and stabilizer frames, landing gear parts, pontoon supports—for many parts where flexibility, machinability and the strength-weight factor are important. OSTUCO is war-geared to keep pace with changing design requirements for military construction The experience thus gained will be placed at your disposal for quality production and prompt delivery of OSTUCO seamless steel tubing for the peacetime transport and passenger planes you are planning to build.

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multiplied, as shown above, to fill out Table II.

The power per engine vs. airspeed may now be plotted for various gross weights, as shown in Fig 8. Effect of change on unbleated airspeed by change in weight at constant power is now easily determined. Thus at 650 hp at 20,000 lb $V = 184$, at 24,000 lb $V = 181$; and at 28,000 lb $V = 178$ mph. The weight correction may be plotted as shown in Fig 10. A reference line is drawn for the standard weight. Then lines are drawn for the various powers showing the airspeeds obtained at various gross weights.

Thus, taking the 650 hp line, indicated airspeed at 24,800 lb = 182 mph; at 28,000 lb $V = 178$ mph.; and at 20,000 lb $V = 184$ mph. This is repeated for all ranges of horsepower.

As pointed out above, Fig 9 is drawn for standard gross weight, in this case 24,800 lb. Our reference line weight is also 24,800 lb. By placing Fig 10 below Fig. 9 a means of correcting Fig 9 for various weights is provided. The result is the standard cruising power chart. To follow through the complete use of the chart, let us take an example:

Let outside air temperature = 60 deg F, hp = 550, gross weight = 28,000 lb, and pressure altitude = 10,000 ft. Find instrument and true airspeeds.

By use of the density altitude correction portion of the curve density altitude is determined. Follow the standard temperature line to 10,000 ft pressure altitude then along the diagonal pressure altitude line to 60 deg F horizontally to the right we read the density altitude—12,000. Follow this density altitude to the 550 hp line. Drop down vertically to the reference line. Follow the guide line to the intersection of the 28,000 lb. line thence vertically and read the instrument airspeed—144 mph.

The reverse problem may also be worked whereby the power required for any true or instrument airspeed may be determined.

In the derivation of the cruising power chart variations of propeller efficiency have not been taken into account. For a more accurate analysis, this may be done when propeller characteristics are available.

The power required in any condition would be varied by the ratio of the respective propeller efficiencies. However, as discussed in Part II of this series, (Aug. AVIATION) for the major portion of the usable range of most aircraft, the propeller efficiency is constant within ± 1 percent, which variation is well within the limits of accuracy of the usual aircraft instrumentation. For very high altitudes, however, variation of propeller efficiency should be considered.

TABLE II—VARIATION OF VELOCITY AND POWER WITH WEIGHT AT SEA LEVEL

24,800 lb		20,000 lb.		23,000 lb.		26,000 lb.		24,000 lb
$W_2/W_1 = 1$		$W_2/W_1 = .806$		$W_2/W_1 = .903$		$W_2/W_1 = 1.024$		$W_2/W_1 = 1.081$
$W_2/W_1 = 1$		$W_2/W_1 = .724$		$W_2/W_1 = .903$		$W_2/W_1 = 1.075$		$W_2/W_1 = 1.265$
V	P	V	P	V	P	V	P	V	P
99	368	82	204	87	252	93	393	99	357
99	268	81	204	97	262	103	393	109	357
109	274	100	232	107	261	114	314	120	371
119	300	109	226	118	261	126	338	131	389
129	331	118	261	128	309	134	372	142	438
139	371	127	283	139	348	145	410	153	495
149	419	139	318	146	380	155	470	164	554
159	473	148	326	158	443	168	552	174	625
169	540	154	410	165	504	176	606	185	718
179	621	163	474	178	582	188	700	198	806
189	719	172	540	184	665	199	800	207	946
199	819	181	625	194	760	206	922	218	1 060

Which Will We Get—Men And/Or Planes?

(*Continued from page* 111)

establishments and services entitled to hire workers shall select only workers from among those referred by the United States Employment Service or through other approved channels according to standards and conditions prescribed by the War Manpower Commission."

The three month old Buffalo plan in effect establishes labor priorities in a given community, with top priority plants getting first choice of labor through USES which decides where job

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applicants may work. But USES can only urge a man or woman to take a specific job. If, for instance, a skilled worker—along with hundreds of thousands of others—is laid off by a tank manufacturer and seeks a job in an aircraft plant he may be told "No, we won't certify you there, you go to work in a shipyard." That man still can (and hundreds like him do) say "to hell with it, I'm going to get out of this crowded town with its long living and shopping conditions and go somewhere else."

So far as the aircraft industry is concerned the Buffalo plan has not worked, as it has operated the airframe manufacturers have not been able to hire the requisite number of new workers. It is feared that any extension of the plan, even though extensively modified, will have the same results in other areas.

Because the Buffalo plan has not worked in aviation—and there is little evidence that the West Coast program will be successful—it should not be inferred that the aircraft industry is "crying in its beer" or looking for an alibi in case production schedules cannot be met. Such is not the case, for West Coast producers presented a manpower plan to government officials long before the beginning of committee migrations from Washington that finally resulted in the program put into effect.

Briefly, the plan provided for out-of-state hiring in labor-surplus areas for plants in critical areas, transportation of workers from surplus to critical areas; guarantee of adequate housing for new workers; cooperation between government and educational authorities to increase employment of sorely needed 16 to 18 yr olds; enforcement of WMC availability certificates to reduce labor turn-over, and liberalization of Selective Service deferment of key men whose induction could only result in serious impairment of the nation's potential airpower.

Like the West Coast manufacturers, Eastern producers also have long been alert to the worsening situation and, through their Aircraft War Production Council, are facing the problem squarely by trying to evolve a long range program that will assure maximum production to the end of the war.

At present their efforts are directed along two phases. First, determination of the true causes for labor turnover and their correction, and second, attempts to retain key personnel. It is in the latter phase that Selective Service plays the largest part. While numerical losses to the armed forces have been no greater than in some other industries, these losses have hit plane manufacturers in particularly vulnerable spots—engineering, production, supervision and, to a lesser degree, the research which is so vital to continuing air superiority. Recent surveys show, for example, that from 25 to 50 percent of engineering personnel of both East and West Coast manufacturers range from 18 to 25 yr of age, mostly unmarried. Like the prize-fight adage, "it's not the number of socks you land, it's where you land 'em that gets the knockout."

Based on past performance records of unheard of production expansion and undreamed of manufacturing efficiencies, the aircraft industry can be expected to do more than its part in putting into battle the greatest possible number of planes—planes that have helped cut ground force losses beyond fondest hopes.

But the problem is bigger than any one industry. It calls for a complete re-examination of the nation's military requirements by those who establish the policies and retain the authority. Both the nation and the aircraft industry are ready for them to decide which we shall have—men or planes?

Fundamentals of Wind Tunnel Control

(Continued from page 183)

pending on the action of a load current relay in the circuit to the d-c driving motor.

In order to assure maximum flexibility of operation, means is provided for transferring from automatic to manual control any major device or function which by its failure would render the entire equipment inoperative. On all installations fundamental protective devices are employed to detect over current, field failure, phase unbalance, over speed, and bearing over temperature. In addition, large installations have protection covering differential current, winding temperature, ventilating air flow, liquid over-temperature of the liquid rheostat, bearing oil or cooling water flow, thermal overload, and other devices as deemed advisable.

Protection for a-c over current, current differential, and phase unbalance current functions to remove all main drive equipment from service immediately. However, those devices which protect against operation under conditions of hot machine bearings, excessive winding temperature, or faulty bearing cooling medium operate to remove the machine from service as rapidly as possible without disturbing the power system to which they are connected. All protective features are automatic in their operation, and suitable devices indicate to the operator, the cause of shut down.

Where large power units of several thousand horsepower are employed, as at Wright Field and Moffett Field, it is important to design the control so that speed adjusting and switching operations impose as little disturbance as is possible on the power supply system. Reduced voltage starting of the 5,000 hp unit is employed, a reactor is used in series with the motor winding during the starting operation in order to limit the starting current to a moderate value. When the machine attains synchronous speed, the reactor is short-circuited thereby applying full voltage to the motor winding for normal operation.

At Wright Field and Moffett Field, wound rotor induction motors are used for fan drive. The rotor windings of these motors are connected to the stator winding of a variable speed synchronous machine; this synchronous machine is mechanically connected to d-c machines which supply power to the 5,000 hp set previously mentioned. Fig. 1 shows the electrical connection of these machines, it is known as the Kramer method of speed control. The variable speed synchronous machine is used, in place of a liquid rheostat, to absorb the slip energy from the rotor of the induction motor. That energy is returned to the a-c system through the d-c machine of the 5,000 hp constant speed set. Control of field excitation on the d-c machines determines power output of the induction motor and, consequently, speed of the fan.

In order to eliminate any system disturbance when the 40,000 hp motor at Wright Field is connected to the power system, the motor windings are excited from the variable speed a-c machine. The speed of the variable speed set is automatically controlled; thus, the d-c machine operates as an a-c generator until the voltage of the fan-motor stator is in synchronism with the a-c system. When the two voltages are synchronized, an automatic device operates to close the fan motor circuit breaker connecting the stator winding to the a-c system. Since the voltage of the fan motor winding is now in synchronism with the system voltage, there will be no disturbance and the motor will not rotate until the variable speed a-c machine is slowed down by field control of the d-c units. As the a-c machine slows down, the frequency of the voltage applied to the rotor of the induction motor will be reduced; thus, the rotor will begin to revolve in order to compensate for the difference in frequency between the voltages applied to the stator and rotor windings.

In order to prevent system disturbances from sudden changes in power demand due to changing the speed of the fan motor, the motor operated speed-adjusting rheostat is designed so as to limit the amount of power change in any one section interval. Since power required by the fan motor increases as the cube of the speed, rate of travel of the rheostat is automatically fast at low



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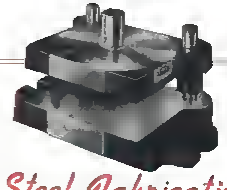
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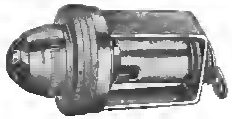
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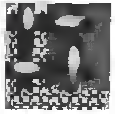
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fan speeds and very slow at high fan speeds.

For normal starting and stopping operations, power change is held to a conservative value. For emergency stopping, the speed adjusting rheostat is operated at as high a speed as possible, at the same time, it must hold the rate of power change within limits which the system can stand. For emergency shutdown, where continued operation of the main drive units would result in damage to machines or equipment, the machine breakers are opened immediately.

With the advent of powered plane models it became necessary to devise some means for operating the plane-model motors, which are small scale size induction units having various pole combinations driven at the desired speed by applying a potential, of variable frequency, to the motor terminals. The plant for supplying variable frequency and voltage to model motors consists of a *constant speed* motor generator set; in addition, there are one or more *variable* speed motor generator sets. The a.c. machine of the variable speed set operates as a synchronous generator and is connected to the model motor power-supply bus. By proper speed control of the variable speed set or sets, the frequency of the a.c. voltage applied to the motors is changed and a frequency meter used to indicate speed of the model motors, since this is determined by frequency of the applied voltage and the number of motor poles.

Control and switching equipment for the plane model power supply units is of the simplest type, since the capacity of the machines is generally 600 hp. or less. Speed control of the *variable speed* m.g. sets is accomplished through voltage control of the *constant speed* d.c. generator and through control of the shunt field excitation on the d.c. motors. Manual adjustment of the various field rheostats is generally adequate; thus, no complicated control apparatus is required.

Meters

A very elaborate metering set-up is included with the control equipment being supplied for plane model power at the California Institute of Technology. In addition to the control switchboard for the power plant, a setup board is added for power distribution and metering of model motor circuits. Six power channel and metering circuits, plus a set of current transformers together with interlocked selector circuit breakers, are included. The current transformers provide ratios from 25/5 to 400/5 amp., in nine steps; this permits accurate metering of current and power to the large range of motor sizes.

A control console, complete with control and selector switches together with indicating meters, is located adjacent to the test section of the tunnel. All of the main drive equipment, the plane model power supply, and the metering equipment can be remotely controlled from this console, while supervision of all apparatus and indication of current, voltage, and power, is provided by suitable instruments. Indicating lamps show the position and conditions of much of the apparatus involved in the automatic control scheme and means are provided for transferring control of main drive and plane model power units to their respective control switch boards.

Design Analysis of the Fleetwings BT12

(*Continued from page* 132)

engine. The Eclipse E5A generator has a maximum output of 50 amperes at 15v.

Other equipment includes a Pesco rotary vacuum pump, Eclipse C-20 hand-electric inertia starter with type A-1 shielded booster coil. Engine controls include propellar control knob, mixture control, with provision for leaning out in front cockpit only. Shutter controls are also in front only. Throttle knobs have radio push button switches for transmitting.

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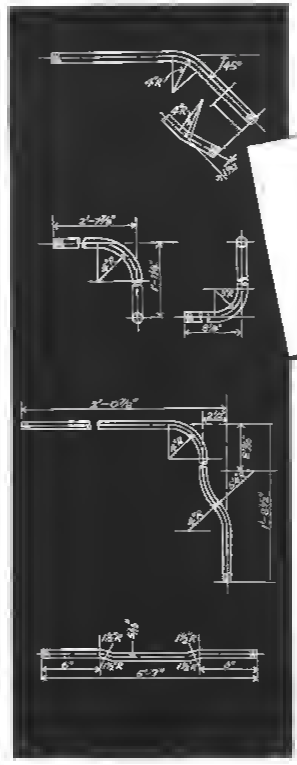


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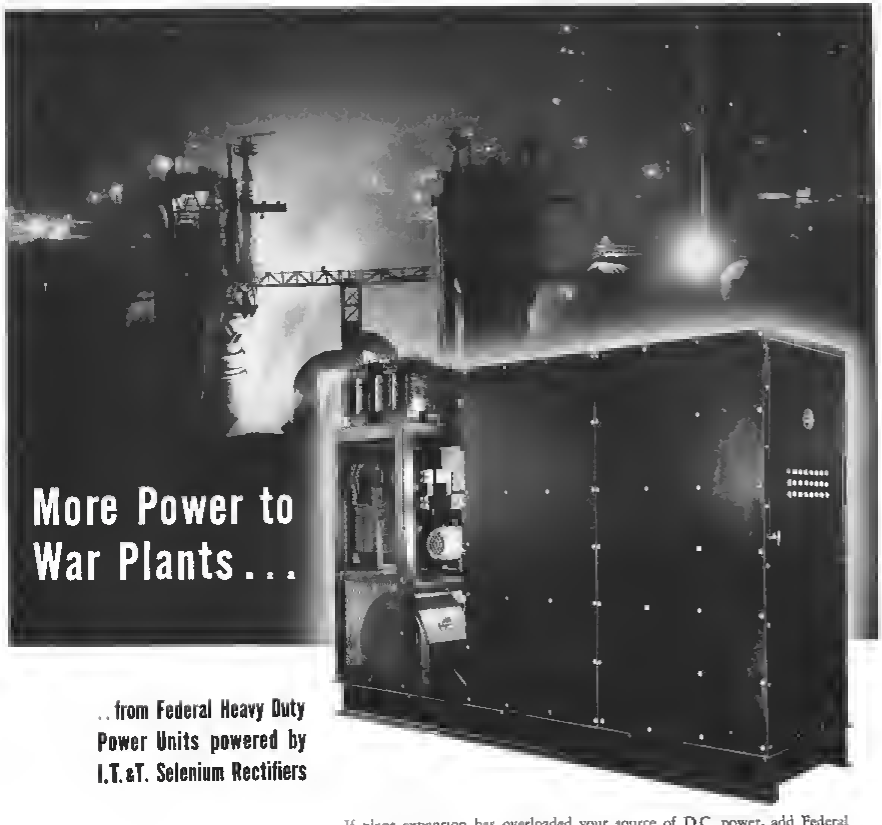
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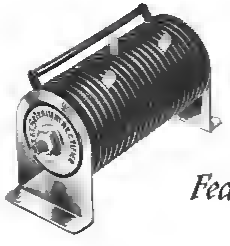
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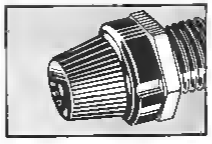
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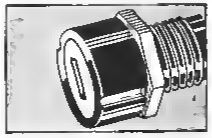


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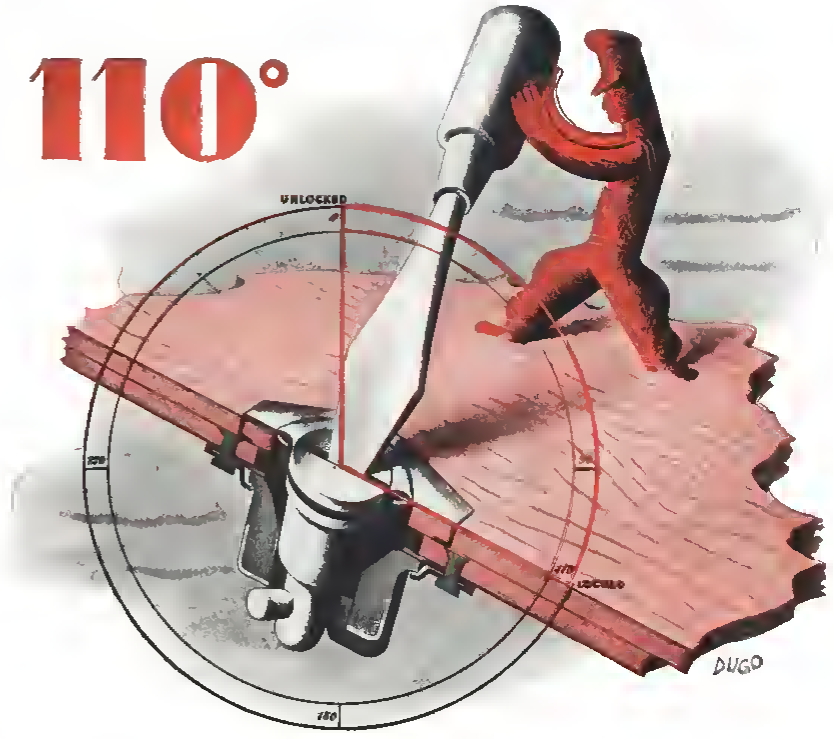
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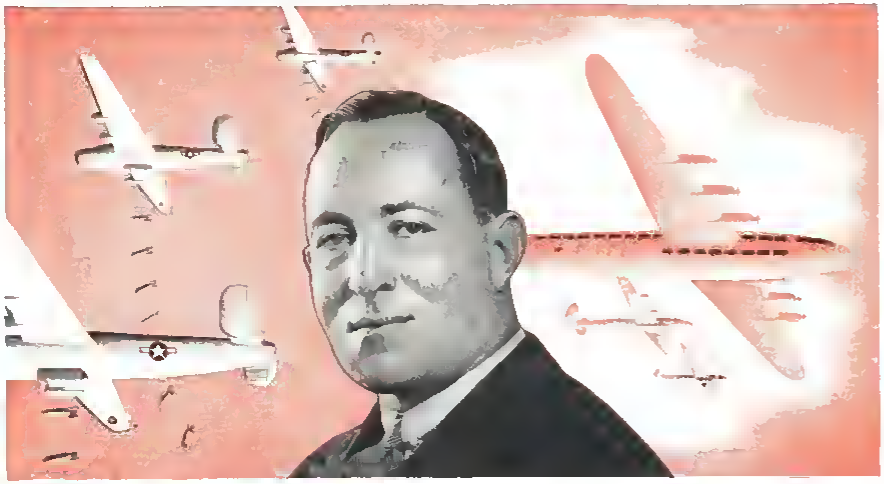


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"AFTER THE WAR, *I do not think it will be economically possible for converted bombers purchased from Army surplus stocks to compete with future cargo and transport ships. For air commerce will come of age, and be able to compete with land and sea transportation, only when we develop peacetime planes as highly specialized as military aircraft — each plane designed for a specific purpose according to shippers' needs, area or points served, volume of pay-load, and optimum speed of transportation.*

"Cost as well as speed must help determine each type we build, but the decisive cost is the cost of operation per ton mile, *rather than the first cost. And if these post war airplanes, operating at a lower rate, save only 10 cents per ton mile over present airplanes, that saving will more than justify the cost of their construction.*

"But even if we are not able to use the planes now flying, we most emphatically can use the personnel trained in the routine handling of freight and passengers over routes which a short time ago would have been considered impossible to fly. These men may revolutionize the methods of air transport established before the war, and help to usher in a new age of air commerce."

* * *

From such practical visions of things to come, Mr. Cohu, and his associates in aviation, are dreaming an industry greater than most of us can conceive—but an industry whose shape is yet to be determined.

In molding that shape, aviation has a great group of silent partners: the TIME-reading men and women on whom aviation will focus almost all its postwar advertising—the people who have the executive jobs, the income, and the habit-of-accepting progress that will help fill aviation's transport and cargo planes, help fly aviation's family planes through the skies of the postwar world.

Believing that the ideas of aviation's leaders are always of interest to the aviation industry, TIME here gives them wider circulation in the name of

AVIATION'S SILENT PARTNERS — TIME — THE READERS OF TIME

MARTIN USA REG U S PAT OFF

"Another Martin First!"



AMERICA'S FIRST *power operated aerial gun turrets were built in 1937 by Martin for its PBM 1 Navy patrol bomber (shown at left). Martin pioneering paid big dividends to America's war effort*

U. S. Planes Pack a Potent Punch thanks to MARTIN-MADE GUN TURRETS

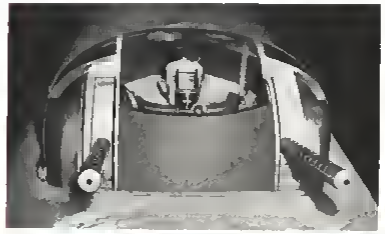
HOW does it happen that Martin, long famed for its fighting planes, is now also one of the world's largest manufacturers of power-operated aerial gun turrets? As far back as 1937 Martin engineers had foreseen the need for powered gun turrets and built America's first for their PBM-1 patrol bomber. When, in 1940, General Arnold proclaimed power gun turrets a "must," Martin was ready with actual experience and production know-how. Results: Martin is now mass-producing turrets not only for Martin aircraft, but for many other U. S. types as well. When you see pictures of high-speed bombers, the chances are 9 out of 10 that they are defended with Martin turrets.

Mass-Producing Gun Turrets

To give U. S. bombers a pulverizing punch and to lessen the need for fighter escort, Martin has turned its entire Sinclair division over to the manufacture of turrets. Martin engineers, seeking ways to turn out turrets faster, achieved these results: The inner ring was cast as a single unit . . . moving assembly lines were perfected . . . and the "chassis" of the turret was cast in one piece, a feat which many experts had deemed impossible. Today, turrets . . . both electrically and hydraulically powered . . . are rolling from Martin assembly lines to make U. S. bombers feared by enemy airmen.

New Improvements

Hardly a week passes without changes or improvements being made in Martin turrets, to keep well ahead of the enemy. Plastics are being utilized to save metal . . . added comfort and protection are provided for gunners . . . and in numerous other ways Martin gun turrets are being improved to give U. S. planes a punch that spells "k.o." for the Axis—and Victory for US.



WICKED WALLOP is packed by these twin 50's in the Martin turret of a Martin B-26 Marauder. At high altitudes where the slightest exertion is an effort, power turrets, easily operated by a twist of the wrist, are vital to Victory.

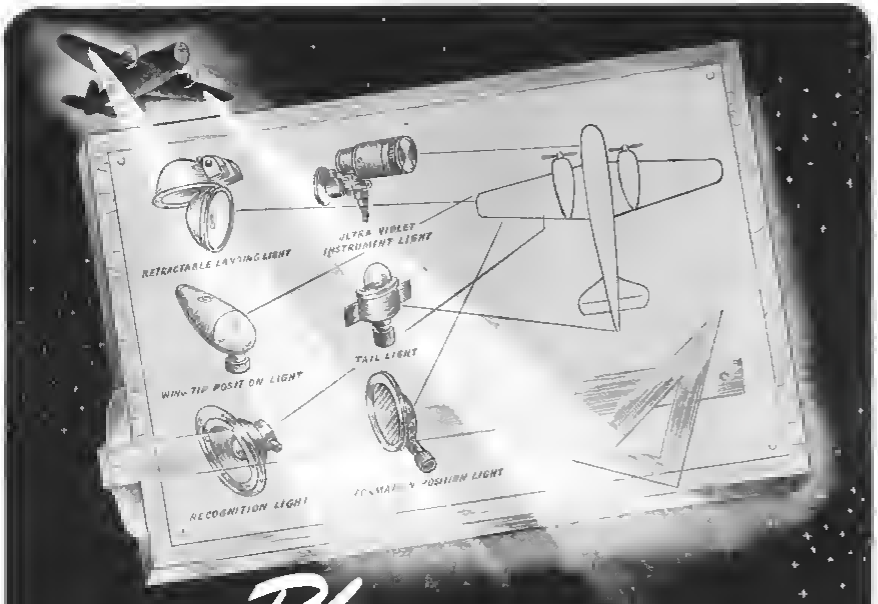


TORRENT OF TURRETS pours from Martin factories, via moving assembly lines like this. Simplified design and advanced tooling boost Martin output. At end of line, guns are installed and turrets are ready to do business with Hitler.

THE GLENN L. MARTIN CO., BALTIMORE, The Glenn L. Martin-Nebraska Company—Omaha

Martin AIRCRAFT

Builders of Dependable Aircraft Since 1909



GRIMES *Plans* TO LIGHT THE WAY

Moey aircraft lights desigeed aed moeefoctered by Grimes for todoy's fighters aed bombers will be flying the commerciol oir lones af tomorrow. Even while conceetrotieg 100% af oer production on wor Items to mohe the present secure, we ore developieg lights thot presoge o brighter fetere.

"Proved ender fire," Grimes lights con be depended upan ta carry aut every tosh assigeed to them. As the desigeer ond producer af more thoe 100 differeet types of oircroft lights now used an all fighting oircroft, Grimes loohs with coefidence to aviotion's limitless peoeetime tomorrow.

GRIMES MANUFACTURING CO. . . . . URBANA, OHIO

If it's Aircraft Lighting...

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Makes it!



REDUCING AIRCRAFT MOTORS TO FIGHTING WEIGHT *also calls for Experience*



THOROUGH ENGINEERING is the basic factor hehind the successful operation of this hydraelic pemp meter aed maey ether special applicatiee motors oe have designed for all types of equipment.

★ It is extremely important in developing future pilots to train them down to *fighting weight* For the same reasons it is imperative that all superfluous weight be removed from aircraft motors ★ Long experience in building fractional horsepower motors for all types of special applications has taught us where and how much weight can be reduced without interfering with the essential electrical characteristics ★ If you are developing or redesigning any motor operated equipment, write for complete information on our engineering service

THE BLACK & DECKER ELECTRIC CO.
KENT, OHIO

Black & Decker

FRACTIONAL HORSEPOWER SPECIAL APPLICATION **MOTORS**

NORTON SERVICE
for Grinding Your Carbide Tipped Tools

There are three types of Norton wheels used for grinding the cemented carbides. Each has its field. For example: *metal bonded diamond wheels* for the off-hand grinding of single point tools; *resinoid bonded diamond wheels* for sharpening multi-blade tools such as milling cutters; *Crystolon wheels* for many roughing operations.

Norton abrasive engineers are familiar with all these types and their proper application. To obtain their help contact direct or through your Norton distributor.

NORTON COMPANY, WORCESTER, MASS.
Distributors in All Principal Cities



Grinding Wheel Recommendations FOR CARBIDE TOOLS

Offhand Grinding (Single Point Tools)

Cup Wheels: Combination roughing and finishing (wet) Roughing (dry)	120 Diamond Metal Bonded 3960/1 17 CRYSTOLON vitrified
Roughing (wet)	100 Diamond Metal Bonded or 100-B98 Diamond Resinoid or 3960/1-17 CRYSTOLON vitrified
Finishing (dry)	39100-H7 CRYSTOLON vitrified.
Finishing (wet)	220 Diamond Metal Bonded or 220-B50 Diamond Resinoid Bonded or 39100-H7 CRYSTOLON vitrified.
Straight Wheels: Roughing (dry)	3960/1-17 CRYSTOLON vitrified
Roughing (wet)	3960/1-17 CRYSTOLON vitrified

Machine Grinding (Single Point Tools)

Cup Wheels: Roughing (wet)	3960/1-17 CRYSTOLON vitrified
Finishing (wet)	3990/1 H7 CRYSTOLON vitrified.
Straight Wheels: Roughing and Finishing (wet)	3980/1-17 CRYSTOLON vitrified

Chip Breaker Grinding

Straight Wheels Roughing and Finishing (wet)	100 B100 Diamond Resinoid Bonded.

Cutter and Reamer Grinding

Cup Wheels Backing Off (Sharpening)	220-B100 Diamond Resinoid Bonded.
Straight Wheels: Ingersoll Cutter Grinder	150-B100 Diamond Resinoid Bonded (1⅛ x ¾ x 1/2).

Surface Grinding

Straight Wheels. Roughing (wet)	100 or 150 Diamond Resinoid Bonded or 3960/1 17 CRYSTOLON vitrified.
Roughing (dry)	3960/1-17 CRYSTOLON vitrified
Finishing (wet)	220 to 400 Diamond Resinoid Bonded, depending upon finish desired or 39100-17 CRYSTOLON vitrified.
Finishing (dry)	39100-H7 CRYSTOLON vitrified

Cylindrical Grinding

Roughing (wet)	100 Diamond Resinoid or 3960/5 K7 CRYSTOLON vitrified
Finishing (wet)	100 to 400 Diamond Resinoid Bonded depending upon finish desired or 39100-17 CRYSTOLON vitrified.

Internal Grinding

100 to 400 Diamond Resinoid, depending upon finish desired (available mounted on spindles in smaller sizes)

Hand Honing or Stoning

Rectangular Sticks	220 or 280 Diamond Resinoid hand hone, or 39280-N CRYSTOLON Stick

Cutting Off

100 or 150 Diamond Metal Bonded for long life; Resinoid Bonded for fast cutting

You'll find much helpful information in the Norton booklet "Grinding Carbide Tipped Tools"—a complete chapter on the selection and use of each type of wheel. Just ask for Form 167B

NORTON ABRASIVES

PACKS THE *Punch* WHEN YOU NEED IT



A G-E POWER PACKAGE THAT DRIVES LANDING GEAR, BOMB DOORS, WING FLAPS, AND TAIL WHEELS

Light, Compact, but Plenty Tough
Careful design, fine materials, and rigid tests—all contribute to the building of an electric drive that packs the punch you need—when you need it.

A superior insulating technique makes the winding structure practically indestructible—even under the severest overloads. The finest magnetic materials available are used to make sure that these G-E power packages will deliver top-notch performance under the most adverse conditions.

Complete Unit—Ready to Install
The power package shown consists of an aircraft electric motor with magnetic brake, reduction gears*, and friction clutch. To keep the number of its moving parts to the minimum, each element is reduced to its simplest terms.

To Designers
This line of power packages can be a great help in simplifying your work. Instead of spending hours co-ordinating the devices that make up a drive, specify a G-E power package. Remember too, these drives save man hours on the assembly line.

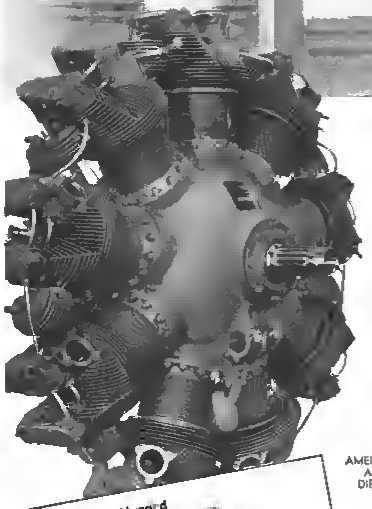
When you have a new design under consideration, see the nearest G E office about the possibility of adapting an available power package to your application. *General Electric Company, Schenectady, N. Y.*

*Gears designed and manufactured by Pacific Gear Works, Los Angeles, Calif.

GENERAL ELECTRIC







TOMORROW THEY WILL FLY!

Today Bill and Jane and Mother look to the skyways! Dad may already ride the airlines. Perhaps he holds his pilot's certificate, too. But tomorrow they all will fly. *Family* flying must be *safe* flying and *safe* flying must be *fire-safe*. That's why the Guiberson air cooled radial diesel engine, using fuel that will not burn even when exposed to flame, is the power plant for the family plane of tomorrow. Guiberson powered equipment is now hitting the Axis in distant corners of the world. It is ready today to serve American industry with fire safe power on land, on sea and in the air!

AMERICA'S RADIAL AIR COOLED DIESEL ENGINE

SAFER THAN SORRY — GUIBERSON — BETTER BE

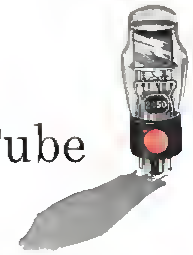
ESTABLISHED 1919

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- Instant Response to the Throttle
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THE GUIBERSON DIESEL ENGINE COMPANY
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DALLAS, TEXAS — CHICAGO, ILLINOIS

How to save paint– with an RCA Electron Tube



THE ELECTRON TUBE, it has been said, can do more amazing things than any other device yet created by man.

And we don't mean the wild-eyed, sleight-of-hand sort of thing so many people have in mind when they talk about "The World of Tomorrow."

We mean cold, hard, practical things—like saving a manufacturer time and money—*today*, not day-after-tomorrow!

Take yourself, for instance. Ten to one you're in the business of making (or selling, or financing) a mass-production item that has to be painted before it goes on sale. So naturally you want to get the most out of the paint you're paying for each month. *That's where an RCA Electron Tube can help you!*

Photo below shows a device we ourselves are using to save money in painting RCA metal tubes. A conveyor carries the unpainted tubes in front of two spray guns and on into the baking oven. A control mechanism, built around an electronic switch, makes certain that the guns spray each tube completely but withhold the spray if, as occasionally happens, two or more successive tubes are missing from their sockets.

An RCA Electron Tube is used to control this operation in the manufacture of tubes. And it may be that RCA can supply your engineers with information about tubes that will enable *them* to design equipment to perform some required job faster, better, cheaper or more safely than you are now doing it.

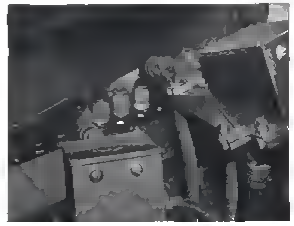
For, just as the Magic Brain of all electronic equipment is a tube, so the fountainhead of modern tube development is RCA.

A copy of our booklet *Electrons in Action at RCA* is yours for the asking. Simply write Room 443, address below.



TUNE IN "WHAT'S NEW?"

RCA's great new show, Saturday nights, 7 to 8, E. W. T., Blue Network.



The Magic Brain that operates this device is an RCA Electron Tube—Type Number 2050. By seeing to it that a minimum amount of paint was wasted against non-existent tubes, it justified the entire cost of installation in a very short period of time.

RCA ELECTRON TUBES

RCA Victor Division • RADIO CORPORATION OF AMERICA • Camden, N. J.

an aircraft

FORGING



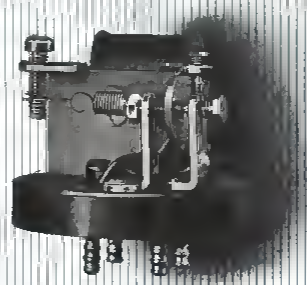
In which every ounce of metal has a job to do . . . . .

that requires perfect performance Ideas and experience gathered by our forging engineers, over a period of 30 years, enabled them to develop the exacting procedures required to forge this Master Connecting Rod. The precise grain flow and fibre structure required to resist complex stresses establishes this forging as one in which the IMPROVEMENT OF METALS BY FORGING has attained the highest standard.

DROP

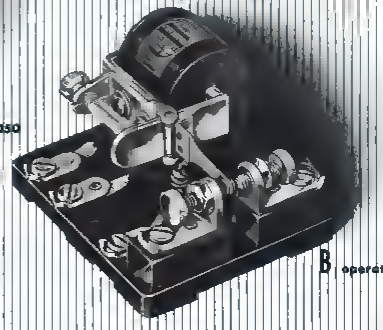
THE STEEL IMPROVEMENT & FORGE CO.

FORGINGS 960 East 64th Street CLEVELAND, OHIO



G operating wattage 0.050

ALLIED



B operating wattage 0.012

Sensitive and Close Differential RELAYS

OPERATING CHARACTERISTICS

B and G Sensitive and Close Differential Relays are made in Single Pole Single Throw, Normally Open . . . Single Pole Single Throw, Normally Closed . . . and . . Single Pole Double Throw

Dimensions: G-17/8 x 17/16 in. B-23/8 x 23/4 x 13/4 in.

Weights G-3 1/2 ounces B-7 ounces

Ruggedness and Sensitivity are built into Allied's B and G Sensitive and Close Differential Relays. These essential factors, Stamina and Lightning Response, enable B and G Relays to withstand the grueling punishment of use in air, sea and land equipment.

B Relays have precision bearings with stainless steel shafts. G Relays have watch type pivoted bearings. These exclusive features keep operating friction to a minimum.

B and G Relays are designed to meet Army, Navy and CAA specifications . . . shock and vibration . . . temperature . . . humidity . . . salt spray . . . etc.

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FACTORIES NEW YORK CITY • PLANTSVILLE, CONN. • CHICAGO, ILL.

$200 BAIL!



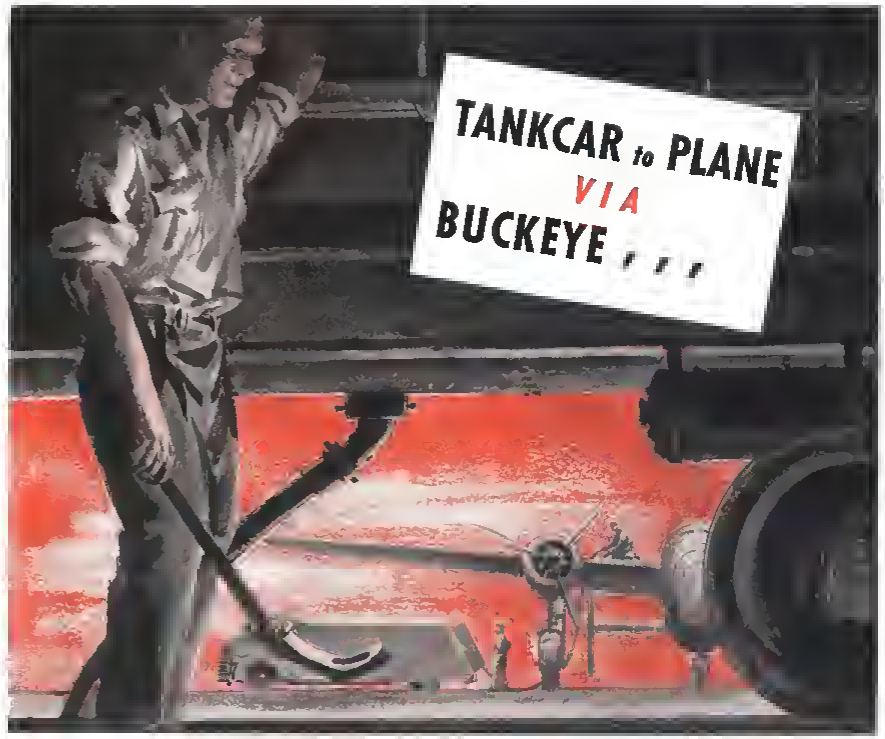
Safety first . . . last . . . and always . . . that's the bail bond which protects our lads who fly. ☆ ☆ ☆ Manning the best planes ever built . . . with guns and equipment to match . . crack airmen emphasize that no small part of their ability to concentrate on destroying the enemy, is their feeling of confidence in their safety chute . . . if need to leave the ship overtakes them. ☆ ☆ ☆ Switlik leadership in design and Switlik efficiency of production are turning out the finest parachute that money can buy . . and are setting new records for deliveries! ☆ ☆ ☆ ☆ ☆

SWITLIK
SAFE-T-CHUTES

Air Power is winning the war . . . The more Bonds you buy . . . the more hours they fly!

SWITLIK PARACHUTE COMPANY
Trenton, New Jersey

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. . . gives the utmost reliability

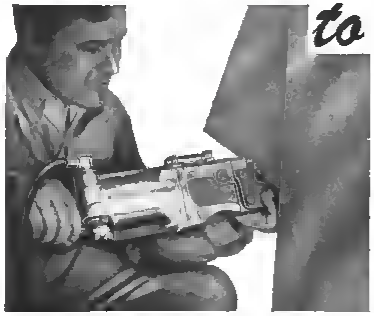
THE way to assure satisfactory refueling is to use Buckeye valves and fittings in your airfield installations. Here are the reasons: *First,* Buckeye equipment has proved dependable for years . . . in every sense of the word, Buckeye equipment is "experienced." *Second,* Buckeye equipment is economical, easy to maintain, easy to use . . . this makes it especially suitable for wartime airfield service, when manpower is at a premium. *Third,* Buckeye valves and fittings for airfields are particularly designed and built for this rigorous service. Airfield, government and Buckeye engineers have worked together to obtain the finest combination of equipment obtainable.

To get the most out of your airfield installations, from tankcar-to-truck-to-plane, we invite you to take advantage of our experience in this line. Choose Buckeye equipment. For suggestions and complete details, write to Buckeye Iron and Brass Works, Dayton, Ohio.

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QUALITY VALVES AND FITTINGS
For Airfield Ground Service

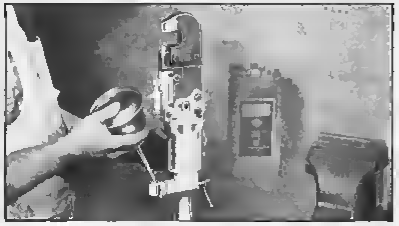
Keep 'Em Oiled

to keep 'em squeezing

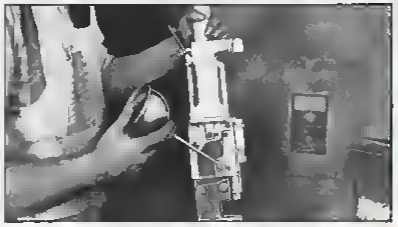


CP Compression Riveters are one-man tools, designed especially for driving rivets with speed and uniform tightness in close quarters. These light, easily handled tools give long low-cost service — but they must be lubricated. » » To keep them operating at top speed, follow the four simple maintenance steps illustrated below.

HOW TO GET MAXIMUM SERVICE FROM YOUR CP COMPRESSION RIVETERS



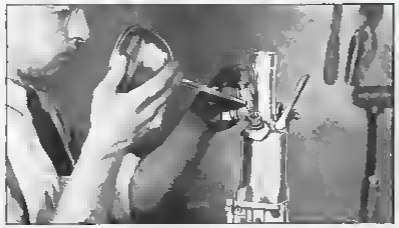
1 Two or three times a day put a few squirts of oil in air inlet and blow through tool.



2 Keep roller bearings well lubricated with a few shots of light machine oil every day.



3 A little oil in the four holes on top of the tool will lubricate springs and rollers.



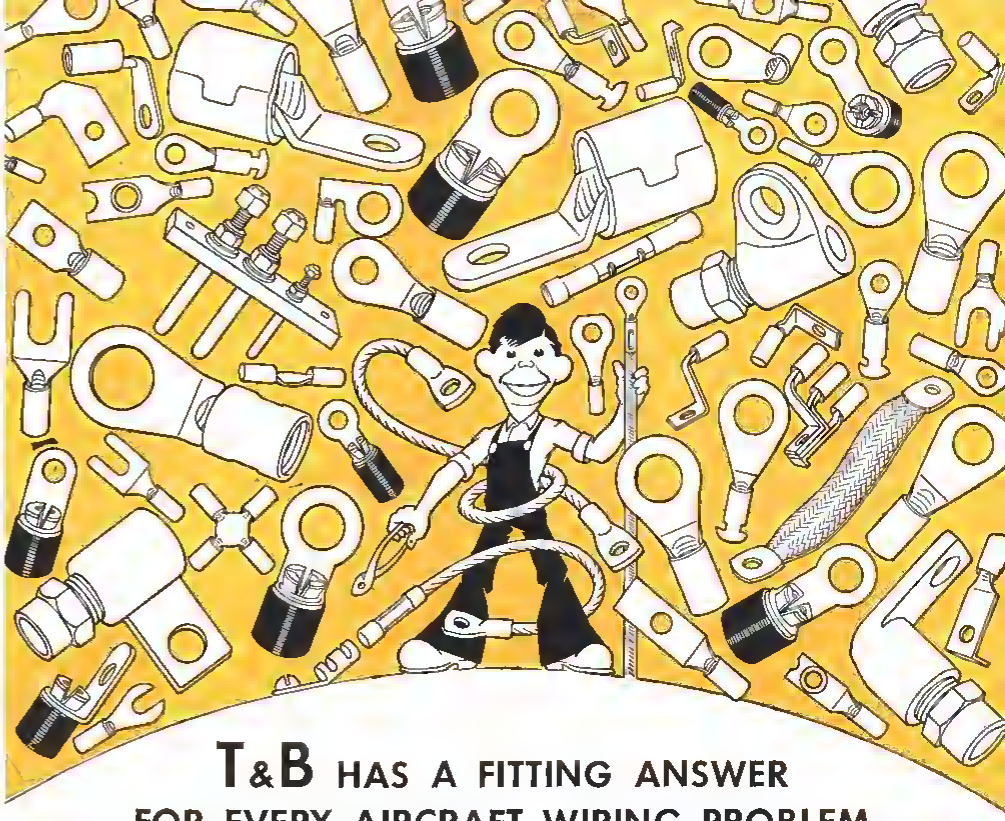
4 Be sure to keep pressure regulator valve properly lubricated with light machine oil.

* * * * * * * * *
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ELECTRIC TOOLS
(Hicycle - Universal)
ROCK DRILLS

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From the beginning of aircraft production, T & B has worked hand in glove with the industry. We are constantly developing new, time-saving fittings—answers to faster and faster production prayers.

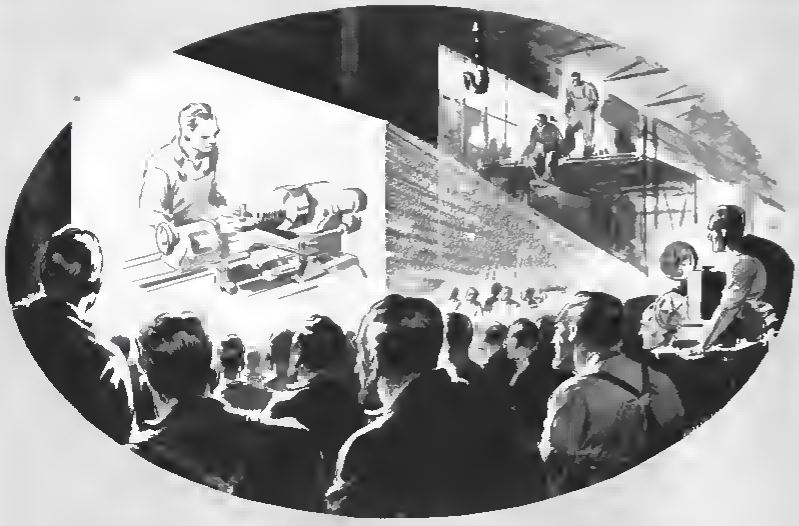
Write us for the new edition of our Aviation Catalog. It gives you engineering details, as well as complete T & B Tool and installation information on all our Aircraft fittings.

Along with all War industries, our production is at an all-time high. We are shipping, *on schedule*, many thousands of items each day.

However, because it takes just as long to procure the critical materials to make little parts as to make big ones, we suggest that you adopt this simple way of protecting *your own* production schedules. Order all small but essential production parts, like T & B fittings, at least four months ahead.

Under the T & B Plan the Electrical Wholesaler is our sole Distributor for these and all other T & B products. He reduces the manufacturer's selling costs, thereby reducing the cost of all electrical material to the user.

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INCORPORATED
MANUFACTURERS OF ELECTRICAL FITTINGS SINCE 1899
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Speed the Training OF NEW LATHE OPERATORS

Skilled manpower is one of the most critical of all war industry problems today To replace the thousands of skilled machinists called to the services, new and inexperienced men and women workers must be trained to carry on the battle of production

To help with the training of new lathe operators, South Bend offers a complete training program of sound films, reference books, manuals, wall charts, and bulletins These represent an authoritative and effective course in lathe operation and modern shop practice. The 16 mm color, sound films have been adapted from South Bend's well known reference and text book, "How to Run a Lathe," now in its 42nd edition.

We are pleased to offer these films and instructional literature to industries and schools conducting pre-employment training classes.

WRITE FOR INFORMATION ON THESE PRACTICAL TRAINING HELPS



MOTION PICTURES—
"The Lathe" and "Plain Turning"—two 16 mm sound films in color on lathe operation. Available on a free loan basis for apprentice training Showing time 20 minutes each. Write for Circular No 8-A.

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HOW TO RUN TO A LATHE—
A practical 126-page operator's handbook; 360 illustrations Written in simple and non technical style. Used as a shop text book by the Army, Navy and Air Corps Price 25c Sample copy free to apprentice supervisors.

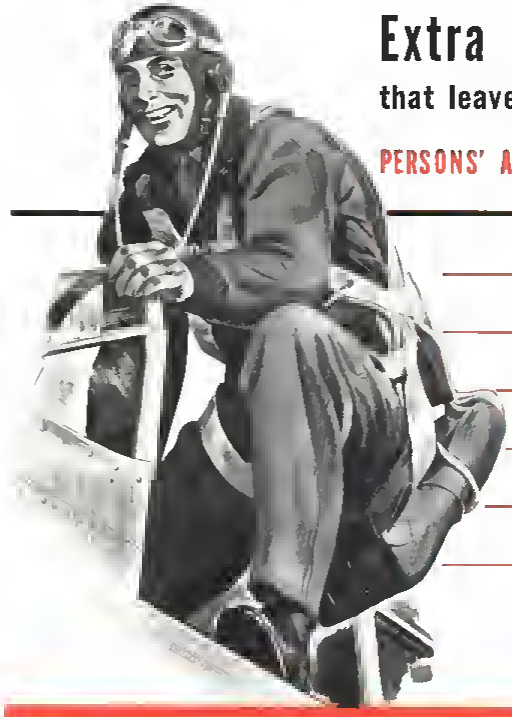
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21-page book, "How to Cut Screw Threads in the Lathe" Shows how to set up a lathe for cutting various pitches of screw threads, setting cutter bits, screw thread formulae, metric threads, etc Price 10c. Sample copy free to apprentice supervisors.

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ARMY-NAVY "E" AWARD

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Extra hands for him...

that leave him free to fly and fight

PERSONS' AUTOMATIC AIRCRAFT CONTROLS

- Air Speed Switches
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Special Bulletins covering Persons' Controls on request.

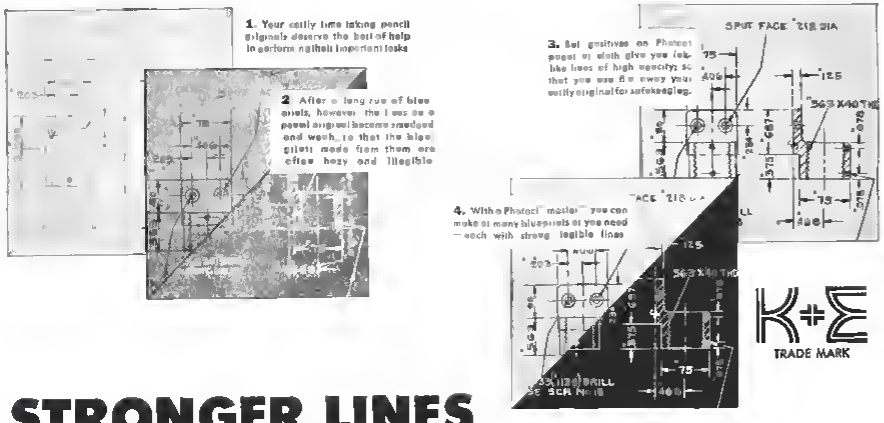
and extra heads for you...

to solve your temperature ond pressure control problems

Backed by 25 years' experience, the recent Persons' developments mentioned above, have been engineered to specifications of many leading aircraft manufacturers. They have proved their merit in action. Our staff of experienced engineers is ready at any time to help you . . . to add extra heads in solving your temperature and pressure control problems

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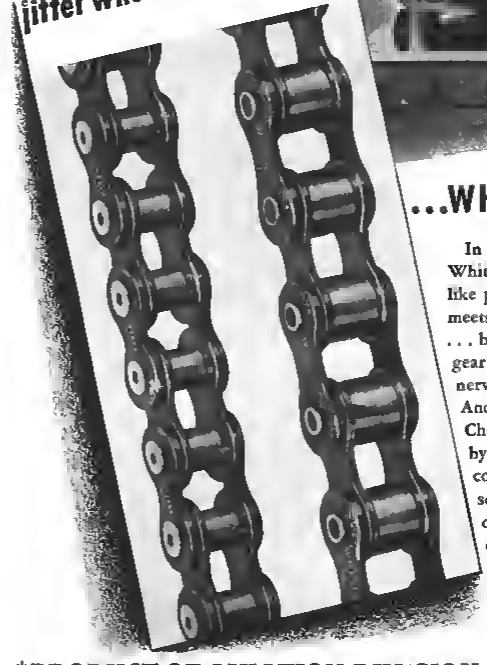
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that won't freeze or jitter when the heat's on...



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And into *your* design-requirements, too, Whitney Roller Chains and Sprockets can be individually engineered by experienced men who personally place at your command all the technical and manufacturing resources of The Whitney Aviation Division, newly organized to meet more effectively the swiftly broadening needs of the aviation industry. Just say when you want to see a Whitney Aircraft engineer. And also ask for your copy of Whitney's new Aircraft Chain Data Book V-160.

***PRODUCT OF AVIATION DIVISION of THE WHITNEY CHAIN & MFG. CO.**

HARTFORD 2, CONNECTICUT

SHOTS FOR G-2



ANOTHER MISSION COMPLETED!

Right where action is hottest, and enemy opposition fiercest, the aerial camera man carries out some of the most vital assignments of modern warfare, with cool daring and technical skill of the highest order.

(A mounted reproduction of this painting is available on request.)

WHEREVER there is *action*—reconnaissance cameras, eyes of the army intelligence, are rolling to spot the target, direct the attack and record the results. To secure the most accurate and informative shots for "G-2", camera shutters click or strip film reels past the lens aperture, in precise relation to the plane's speed and height. Such precision is obtainable only through the aid of specially designed electric motors.



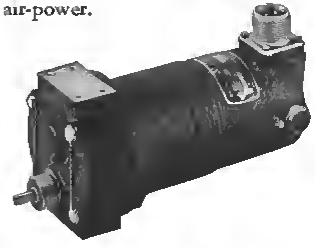
For such vital purposes, Dumore engineers have developed more than 30 special aviation type fractional horsepowet motors, smaller, lighter, more powerful, than were thought possible only a short time ago. They operate de-icer equipment, ammunition boosters, retractable landing gear, and a wide tange of diffetent, but essential accessories, calling for gear reductions, clutches, brakes, gas-proof enclosures, and other special features. Including these accessories, and balancing the weight and space restrictions against the power needs, was a triumph of Dumore engineers. A parallel achievement was the volume production of these motors, to speed the growth of our fighting air-power.

"FIRST ASSISTANT CAMERA MAN"

Aerial photography is largely automatic through the use of special types of motors such as Dumore has developed for operating shutters, timing the exposure, developing the film and processing the picture.

On applications where overtravel must be held to a minimum, such as aerial cameras, retractable landing gears, cowl flaps, Dumore developed a combination magnetic clutch and brake, to bring the output shaft to a stop within 1/4 second when the circuit is opened. Gear reduction units are also included, and the motors are conditioned to operate over wide temperature and altitude ranges.

Dumore engineers are well equipped to aid you in the application of fractional horsepower motors.



FOR EXTRA POWER HOURS **Dumore**

Headquarters for Fractional Horsepower Aircraft Motors

Dumore

PRECISION GRINDERS

FOR BETTER MAINTENANCE AND REPAIR



PUT FACTORY ACCURACY IN FIELD MAINTENANCE

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Dumore distributors, located in all principal cities, can give you complete details on capacities of various models—or write for complete catalog, today!

THE DUMORE COMPANY, RACINE, WISCONSIN

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The Industry depends on KARDEX controls

THE pilot's job allows *no margin for error.*

The same holds true for Aviation... America's No. 1 Industry. *Control* is the life-blood of not only the vital administrative paper work, but of the *entire* assembly line, too.

From the top flight of the nation's aircraft builders to the small manufacturers of parts, you will find at least one of many Kardex Visible Control Systems on the job ... each "tailored" to meet specific problems of purchasing, personnel, materials, engineering, tool cribs and a host of others. Yes ... even controls on absenteeism and worker transportation!

Kardex Visible Systems are not just "bought". Each is the result of exhaustive analysis by a highly-trained Remington Rand Systems and Methods Technician who investigates, plans, recommends ... *and then services the installation!*

Aircraft manufacturing executives, who appreciate the high value of "control" in their industry, will find the story of Kardex in the Bell Airacobra plants very informative. Write today for a free copy of "Systems Narrator No. 571" containing Bell's "success story".

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REMINGTON RAND
BUFFALO 3, NEW YORK

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A BUMPY landing with a 25-ton bomber is no "love-rap!" The impact can be as great as 80 tons. That's why Boeing engineers designed into the Fortress' landing gear the greatest possible strength consistent with required compactness and light weight. And that's why almost every part of its landing gear —actuating arms, links, struts and hydraulic cylinders—is made of alloy steels in various forms.

Only Alloy Steel can so safely take the terrific shock loads in landing gears, can so well withstand the destructive fatigue in engine mounts, or carry the stresses concentrated at vital points in primary aircraft structures. It is for such important applications that U·S·S Carilloy Aircraft Quality Alloy Steels are preeminently fitted.

More than high strength-weight ratio distinguishes the Carilloy Alloy bars and billets that bear the "AC" — Aircraft Quality—stamp. To earn this rating the steel must run the gauntlet of very strict micro and macro examinations that prove its fitness for airplane parts, engines and accessories.

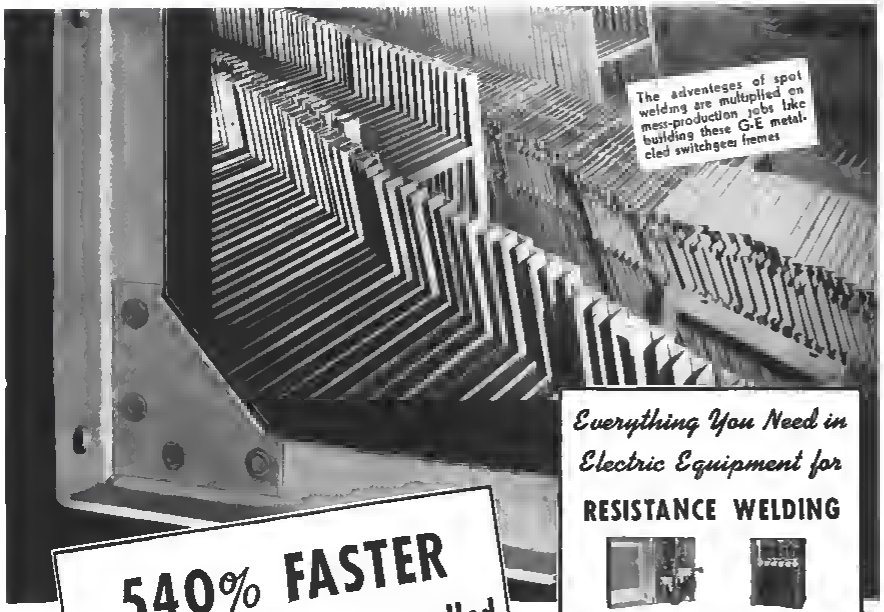
U·S·S Carilloy Sheets and Strip for aircraft construction are produced by the most modern equipment for rolling and subsequent processing operations to provide a smooth, scale-free surface finish assuring maximum resistance to fatigue.

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UNITED STATES STEEL



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with Electronically Controlled SPOT WELDING

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Electronically controlled resistance welding is speeding the construction of light metal and stainless steel aircraft. It's replacing soldering, too, saving tin and time. Joining like or unlike metals and alloys. Giving dependable, *consistent* results. Making gastight seams. Helping speed the training of new operators. Resistance welding is ideal for high-production operations on heavy or light work, portable or fixed.

Whatever your application, be sure to specify G-E electronic control and other electric accessories. For further information, contact any G-E office, or your resistance welder manufacturer or agent. Or write General Electric, Schenectady, N. Y.

Everything You Need in Electric Equipment for

RESISTANCE WELDING

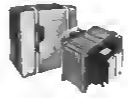
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Electronic weld and sequence timers


Weld-recorders—to record electrical input of EVERY weld


Ignitron tubes for all purposes


Cables and instruments


Air circuit breakers and welding transformers

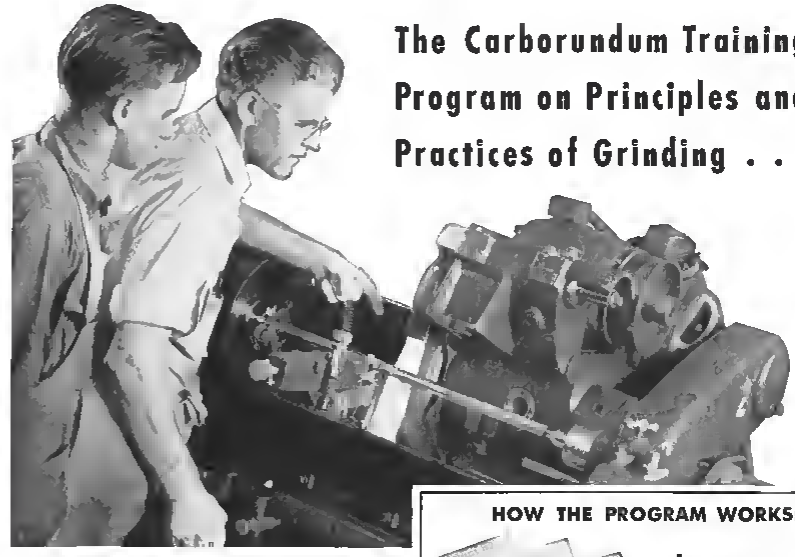

Ignitrons for power-factor improvement


Motors and control

Speed Production Electronically

GENERAL ELECTRIC

FREE! FOR TRAINEES IN INDUSTRY!



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THE problem of training green workers for precision war work is one of the biggest jobs industry has ever tackled.

Here is our contribution to its solution—a streamlined course in the principles and practices of grinding, offered to trainees in *your* Plant!

The purpose of the Carborundum Training Program is to explain in simple, non-technical terms the fundamentals of grinding and thereby help make better grinder hands of trainees, apprentices and students.

This course is designed for both classroom and small group instruction. Since its introduction, it has been widely adopted throughout industry. We hope it may help you, as it is helping others, to simplify the training of new grinder hands and to speed them on their way to higher production and greater accuracy.

THE CARBORUNDUM COMPANY

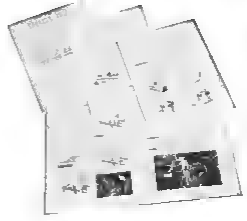
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(Carborundum is a registered trade-mark of and indicates manufacture by The Carborundum Company)

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Educational Service Department
THE CARBORUNDUM COMPANY, NIAGARA FALLS, N. Y.

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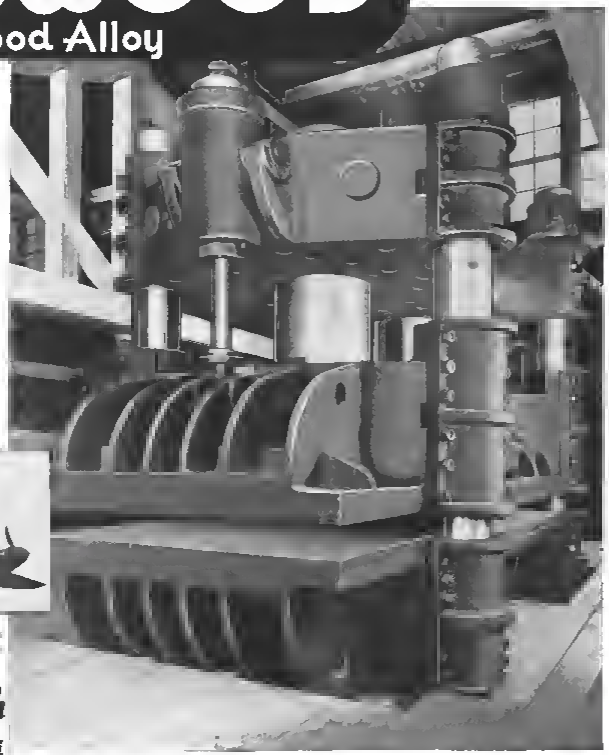
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based on total pressure up to 5,000,000 lbs. • 300 K.V.A. • 540,000 B.T.U.'s per hour



● Britain's de Havilland Mosquito bombers are now using birch veneer made by Pluswood.



Here is a *new high density engineering material* with an exciting weight-strength ratio

For post-war planning: Pluswood offers the aviation industry a new material of fixed engineering description, lighter than aluminum but with a structural strength that compares favorably with many metals. It is based on what is by far the most powerful press in the entire plywood industry, working in combination with the largest high frequency Thermex heating unit ever applied to wood for this purpose.

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WOOD + Select northern birch or maple—cut from vast tracts of timber reserves in northern Wisconsin and Canada.

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HEAT + 300 K. V. A. high frequency electrostatic generating unit—largest in the country for this purpose — delivering 540 000 B. T. U.'s per hour.

PRESSURE Largest and most powerful press in the plywood industry — with total pressing capacity up to 5 000 000 pounds.

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ALGOMA FOREST PRODUCTS, Ltd., Bruce, Ontario, Canada

EACH TRUCKER GETS GIANT-LIKE RESULTS...

So Important IN INTRA-PLANT TRANSPORTATION

Automatic PALLET TRANSPORTER

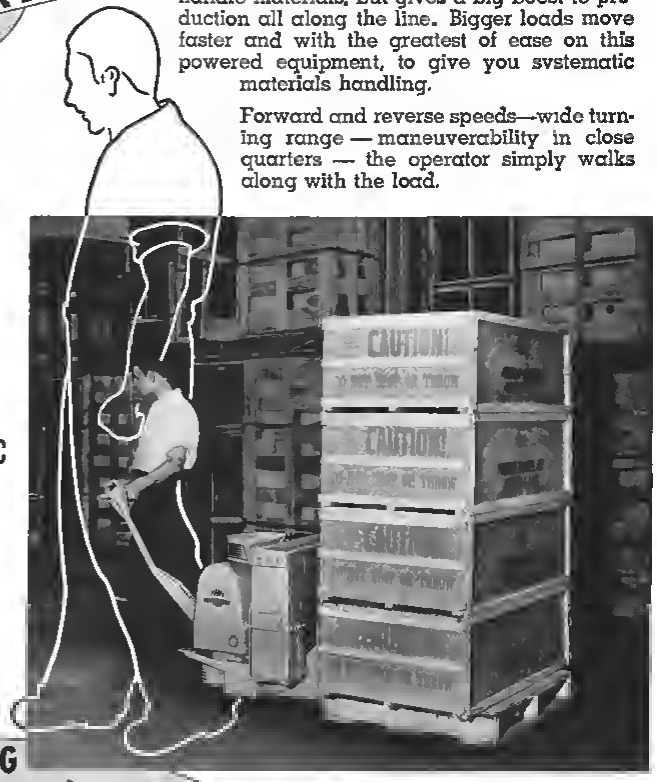
The TRANSPORTER not only greatly increases the efficiency and ability of your men who handle materials, but gives a big boost to production all along the line. Bigger loads move faster and with the greatest of ease on this powered equipment, to give you systematic materials handling.

Forward and reverse speeds—wide turning range — maneuverability in close quarters — the operator simply walks along with the load.

★ POSITIVE HYDRAULIC BRAKE ★ FRONT WHEEL POWER DRIVE ★ CONTROLS IN STEERING HANDLE ★ SHOCKLESS HYDRAULIC PLATFORM LIFT WITH EASY FOOT CONTROL ★

For use with either open or double-face pallets —loads up to 4000 lbs.

TRANSPORTER Platform Type Lift Trucks are available also, in 4000 and 6000 pound capacities.



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DIV. OF THE YALE & TOWNE MFG. CO.
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USE THE **COUPON**—get details on this truck that operates at the trucker's command.

AUTOMATIC TRANSPORTATION CO.
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Gentlemen: Please furnish complete information on the "TRANSPORTER" without obligation.

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NEW!

HI-SPEED DIMPLER

This newly engineered equipment increased by FIVE TIMES the Dimpling production in one of America's giant Aircraft Plants

Equipment Coordinated by AIRCRAFT ENGINEERS

YORK ELECTRIC YOKE. HI-SPEED AUTOMATIC DIMPLER ADAPTER. PRESSURE PAD DIMPLING TOOL AND PNEUMATIC SQUEEZER . . .

Over 100 Perfect Dimples a Minute!

Without Spoilage—Without Cracks—Minimum of Manual Labor—No Foot Work—More Production—Better Work—Less Fatigue

This newly coordinated Dimpling Equipment solved a troublesome problem in one large Aircraft Plant, and now the same benefits are passed on to the Industry—Speeds production

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YORK ELECTRIC TOOL CO.

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WALTER SNOW FIGHTERS

Keep Runways Clear in any Blizzard!

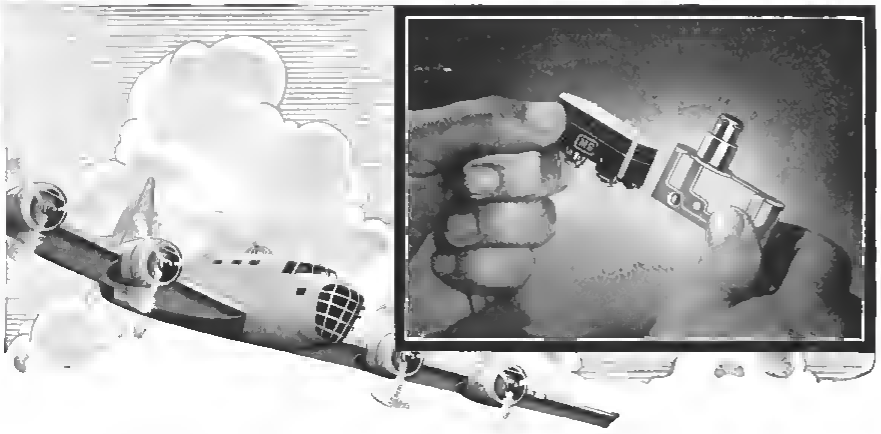
The first commandment at any airport during the snow season is: "KEEP THOSE RUNWAYS CLEAR OF SNOW" That calls for snow fighting equipment that will remove snow so swiftly that no blizzard can catch up with it.

Walter Snow Fighters clear 16 foot widths at speeds well above 20 m.p.h. These speeds produce ideal snow dispersion, throwing it far to the side and preventing formation of dangerous snow banks. Thus one Walter Snow Fighter will clear as much snow as several ordinary units. And if roads in the vicinity of the airport should become choked with heavy drifts, you can count on the Walter Snow Fighter to open them up.

No other equipment can approach this performance, because only Walter Snow Fighters have the exclusive Walter Four-Point Positive Drive. This feature provides FOUR driving wheels with full traction in each, eliminating "spinning" and stalling in snow and icy conditions. Many other special engineering features. Send now for descriptive literature.



WALTER MOTOR TRUCK CO., 1001-19 IRVING AVENUE, RIDGEWOOD, QUEENS, L. I. N. Y.



Four Good Reasons for Standardizing on These Micro Switch Actuator Brackets

Designed to Carry the Air Corps Approved Type R-31 Micro Switch . . .
For Complete Details of This Switch, Refer to Our Aircraft Catalog No. 70

These actuator brackets require no deviation permit as they are considered a part of the aircraft.

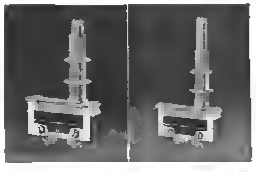
They are all specifically designed to accommodate the Type R-31 Aircraft Micro Switch.

Their use permits faster and easier installation of the Type R-31 Aircraft Micro Switch.

They make field replacement of Type R-31 Aircraft Micro Switch easy without disturbing bracket.



This new Type M-B skeleton bracket saves weight. The plunger on this bracket has a definitely controlled pre-travel and over-travel—a total of ¼". The Type R-31 Aircraft Micro Switch is sturdily supported in this skeletonized bracket by flush headed screws with lockwashers. The mounting holes in the top of the bracket are on standard 1⅜₆" centers and accept No. 6-32 bolts.



The Type M series of panel mounting brackets offer three lengths of threaded stems for easy positioning by hex nuts and lockwashers. Switch operation takes place in the first ½" of plunger travel.

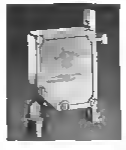


Over-travel ¼" or ⅝" beyond the point of switch operation is provided. The Type R-31 Aircraft Micro Switch is carried on two thru-bolts as shown in the illustrations.



The Type T series bracket has met instant adoption as a throttle warning switch, singly or in gangs. They are operated by cams on the throttle quadrant or dogs on the cables. Any switch held depressed can be instantly opened by the manual release without disturbing others in the gang. As a general use limit switch the Type T bracket without the release is a sturdy mount and actuator for Type R-31 Aircraft Micro Switch. Two thru-bolts make replacement easy.





The Type H series of aluminum housings, one of which is illustrated here, are complete with a plunger actuator which can be sealed against splash, dirt and oil. It is fitted with "A N" outlet fittings, either straight or adjustable, 45 degrees. The plunger over travel beyond the point of switch operation is ⅜" on the Type H and 1¼" on the Type HO3. The Type R-31 Micro Switch is easily installed on two mounting pins within the housing.

Data sheet No. 27 gives full engineering data on the series M brackets.



Catalog No. 70 furnishes general data on switches for aircraft. Ask for as many copies as you need.

Micro Switch Corporation, Freeport, Ill.
Branches: 43 E. Ohio St., Chicago (11) • 11 Park Pl., New York City (7) • Sales & Engineering Offices: Boston • Hartford • Los Angeles

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MICRO SWITCH

Made Only By Micro Switch Corporation . . . Freeport, Illinois



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This VICTOR Aircraft Maintenance Unit No. 1 has been specially designed to meet the most stringent specifications for operating accuracy, maintenance simplicity and trouble free service life.

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VICTOR EQUIPMENT COMPANY

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NOW THAT WE'VE COMPROMISED ON A FILTER, GENTLEMEN . . .

It shouldn't be so tough to Pick a Plane Filter

- No weight
- 100% efficient
- Need no space
- Last forever
- Never need service
- No restriction
- Delivery yesterday

All you do is to line up the requirements for a perfect filter—list on the left for your convenience—and see how close to it you can get.

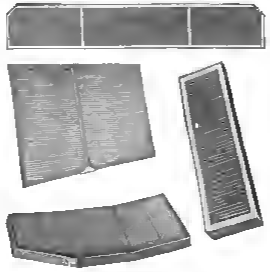
For instance, it doesn't do any good to get a *light* filter if it doesn't stop high-velocity dirt. Or high efficiency with excessive restriction. Granted?

The important thing to remember is that a filter, like a plane, must have more than one quality. And, like a plane, its final qualities are matters for intelligent compromise.

Having pioneered in the development of aircraft filters, Air-Maze engineers have nearly 20 years' experience in the compromises necessary to turning out the most nearly perfect aircraft filter for any particular plane. Records of the many types of Air-Maze filters on the world's battle fronts show these men know their business.

Maybe they can help you get more of the qualities you need, without sacrificing too much of those you'd like to have.

A Few Typical AIR-MAZE *HIGH-VELOCITY* Aircraft Engine Filters



How much Lighter?

We will gladly tell you the advantages of weight savings and efficiency of Air-Maze filters. Include engine and installation data with your inquiry.

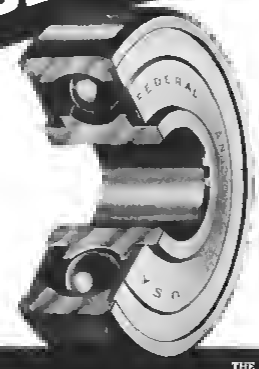
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SPECIALISTS IN AIR FILTRATION



Federal aircraft BEARINGS



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Makers of Fine Ball Bearings

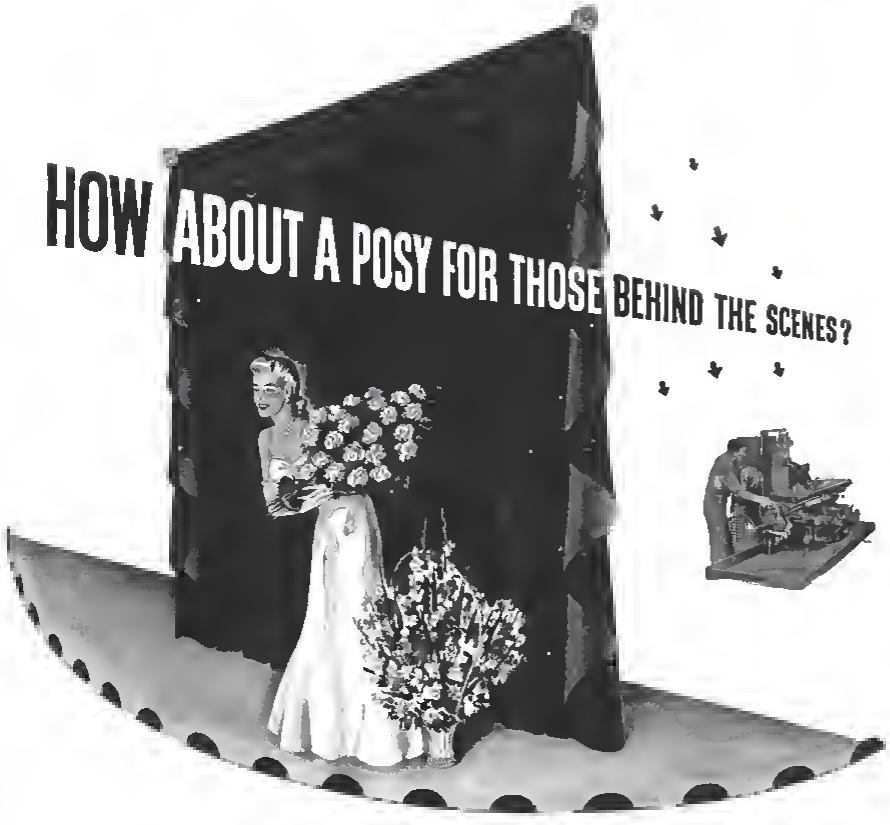
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America's gigantic war effort is the most spectacular production of all time Its drama is breathtaking. Its cast of characters huge. Some of the actors must remain in the background . . . but their performance is none the less essential

We here at Joyce have been destined to play that kind of role You won't find our name in the headlines. We'll be unmentioned in thrilling stories of naval and military victories But we're gratified to know that we've been able to help bring about those victories For the products of Joyce artisans can be found in battle on land and sea, in the air and under the sea—indispensable parts of our fighting forces' weapons and equipment—parts whose dependability and precision functioning are vital.

Joyce is proud of the justly deserved honors awarded American Industry, for the parts, assemblies and machines built by Joyce engineers and craftsmen are helping many of the nation's greatest war production plants to attain and maintain new production records

If you find it difficult to meet your war contracts, let Joyce's specialized production skill show you the way And, when Victory comes, that same Joyce "know how" will be immediately available to assist you in licking postwar production problems A Joyce representative will be glad to call and explain the unique advantages we are equipped to offer

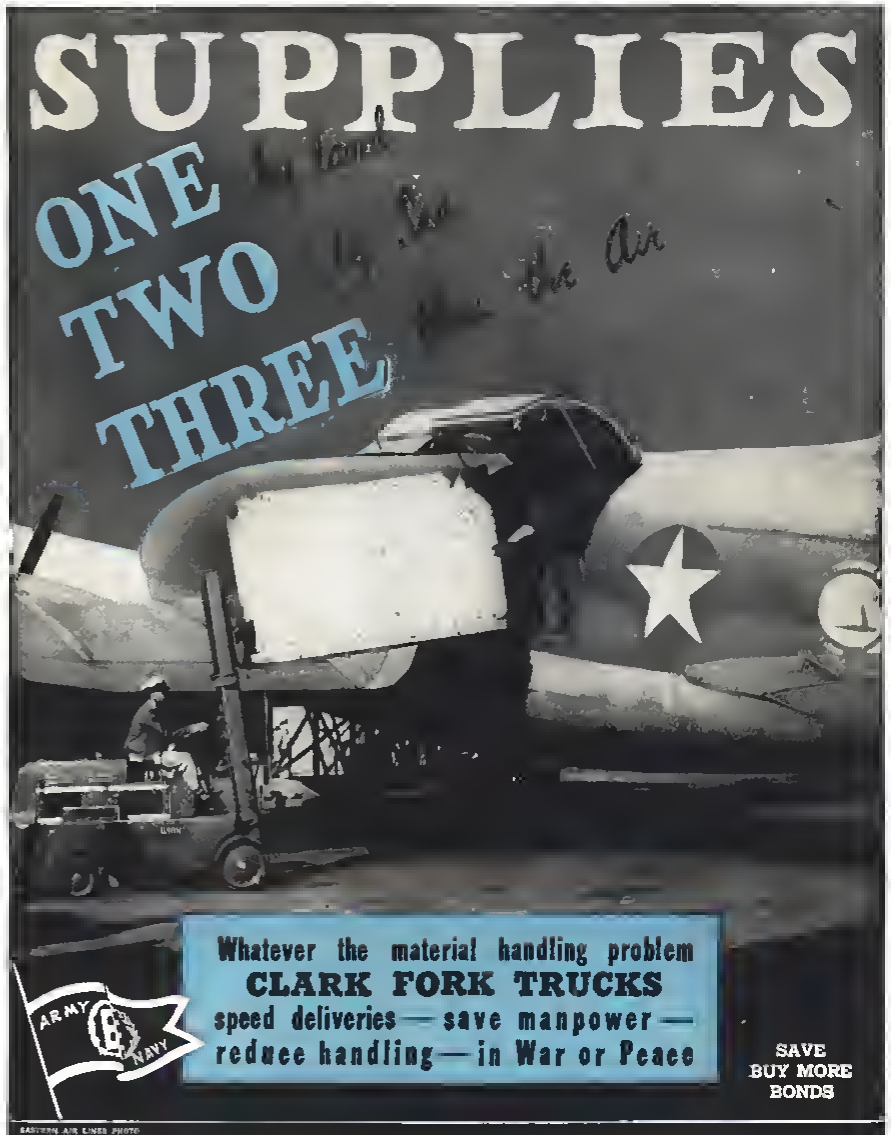
★ *More Bonds over here mean more Bombs over there* ★

JOYCE
Machine Company
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★
MANUFACTURERS OF PRECISION PARTS FOR ALL KEY INDUSTRIES

BEHIND THE MAN ▸ BEHIND THE MAN ▸ BEHIND THE GUN

SUPPLIES

ONE
TWO
THREE



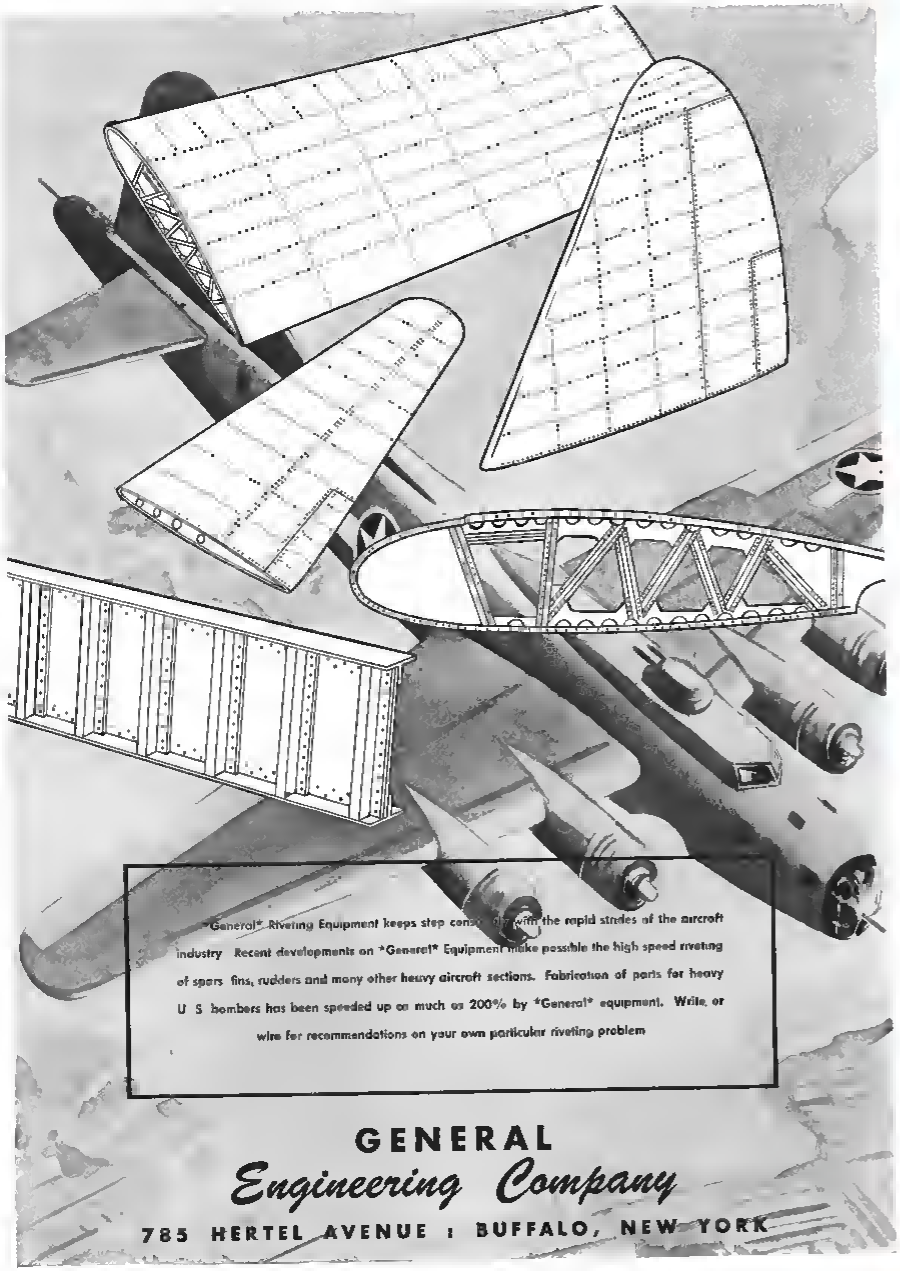
Whatever the material handling problem
CLARK FORK TRUCKS
speed deliveries — save manpower — reduce handling — in War or Peace

ARMY NAVY

SAVE
BUY MORE
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EASTERN AIR LINES PHOTO

CLARK TRUCTRACTOR
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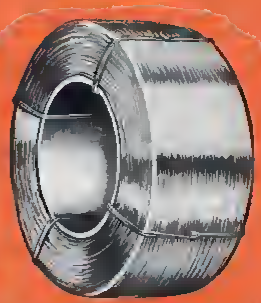


"General" Riveting Equipment keeps step constantly with the rapid strides of the aircraft industry. Recent developments on "General" Equipment make possible the high speed riveting of spars, fins, rudders and many other heavy aircraft sections. Fabrication of parts for heavy U. S. bombers has been speeded up as much as 200% by "General" equipment. Write, or wire for recommendations on your own particular riveting problem.

GENERAL
Engineering Company
785 HERTEL AVENUE : BUFFALO, NEW YORK

FOR AIRCRAFT PARTS ASSEMBLY...

YOU GET 10,000 STITCHES FROM A 5 LB. COIL OF WIRE



The American Steel and Wire Company's aircraft stitching wire, used in Morrison Stitchers, provides high tensile strength . . . sufficient to penetrate aluminum sheets and other metal parts and pass shearing and vibration tests.

. . . ON A MORRISON WIRE STITCHER!

DRAMATIC savings in vital meterial and time are made possible by MORRISON AIRCRAFT METAL STITCHERS. Man hours have been cut over 86% in one plant alone. The first five jobs changed over to Morrison Stitching took but 67 man hours in a single week — against 495 man hours formerly required for riveting. In addition, Morrison Aircraft Metal Stitchers are easy to operate and simple to maintain.

If you are riveting or welding Aluminum, Stainless Steel, Plastics, Cork, Rubber, Asbestos, Wood or Canvas, it will pay you to investigate Morrison Aircraft Metal Stitchers AT ONCE! Write or wire today for Bulletin 9 F.



MORRISON STITCHERS
PRODUCTS OF THE SEYBOLD DIVISION
HARRIS-SEYBOLD-POTTER COMPANY
DAYTON 7, OHIO

Actual photograph, magnified ten times, of cross section of stitch driven through two sheets of 24ST .040 Aluminum.



IN SEARCH OF PREY

"Getting on top of the job" applies literally to battle in the air. The plane with the highest critical altitude usually wins . . . and it is the specific job of Bush Intercoolers to provide superior critical altitudes for warplanes of the United Nations. This experience . . . specialized in the heat transfer field and applied to the hundreds of commercial and industrial applications which will become available when the war is won . . . will one day help many a business to "get on top of the job." BUY WAR BONDS.

BUSH MANUFACTURING CO. HARTFORD CONNECTICUT

Now it can be told how

AMERICAN HAMMERED developed

Chrome



World's largest porous chromium plating plant.

PISTON RINGS

This is the story *behind* a story . . . the first public disclosure of an important new process that helped write hundreds of tales of Allied air supremacy.

Now the Axis has heard it the hard way, our story is a military secret no longer . . . and American Hammered can tell you the facts about its revolutionary new process for armor-plating piston rings. A story that holds *double* promise for America, because the vital contribution these rings are making to victory forecasts important service in the post-war industrial and transportation fields.

By the patented PORUS-KROME* process—perfected for piston rings by American Hammered before Pearl Harbor—the outer ring surface is electroplated with harder-than-steel, porous chromium plating. Oil clings to this new surface of special chrome "with pores,"—keeping the cylinder walls lubricated. Even during 700 m.p.h. fighter-plane dives . . . even when marine engines roar unchecked in sea battle maneuverings . . . this special surface of chrome "with pores" adds new power to high speeds, and hours to operating life. In desert flying, this new, porous chrome guards cylinder walls against the destructive action of sand and dust found at altitudes up to twenty-thousand feet!

To get these rings into every Army and Navy engine without delay, this organization constructed and is operating the largest porous chromium plating plant in the world.

This great development in engine performance has impressive post-war significance for all American Hammered customers.

KOPPERS COMPANY

American Hammered Piston Ring Division

BALTIMORE, MARYLAND

* VAN DER HORST PROCESS

KOPPERS

THE INDUSTRY THAT SERVES ALL INDUSTRY



Sure You're Going To Miss It. Autumn and outdoors. The woods and fields. Game and a good dog. Still nights under the stars. Flapjacks and a log fire. We understand. We miss it, too. But you won't mind nearly so much if you do some wartime hunting. Here's how...



You Can Help To Win The War as an Auxiliary Policeman in the Citizens' Defense Corps. It's fun to train and work with your own local police department. And no hunting was ever more packed with real adventure. Just call your local Office of Civilian Defense now...

If there's NO HUNTING for you this year



Then Throw Out All Your Old Ideas of Geography, and think of all the distant spots you've always longed to hunt.

They'll all be *right next door* when this war's over, because then you'll be *flying* your own Cessna Family Car of the Air. . .that is, if you're over 16 and not too far over 60.

True enough, this airplane that everyone can buy and fly is going to be the Family Car *tomorrow*... but only because today we're devoting every ounce of our 32-year experience in aviation to the number one job of building twin-engined Cessna Bobcats for Uncle Sam's war birds. As soon as that job's done, *once and for all*, we can start building your Family Car of the Air for you.

COPR. 1943 CESSNA AIRCRAFT CO.

Cessna

Priority Delivery by Buying War Bonds Now...
Be one of the first to own a Cessna Family Car of the Air after the war. Orders are bound to exceed production. But you can get a preferred listing for early postwar delivery. No obligation to buy. Costs you nothing. Write us today for the simple priority plan. CESSNA AIRCRAFT COMPANY, Box 1616-A, Wichita, Kansas.

ARMY (E) NAVY
Cessna

SYMBOL OF AIRCRAFTSMANSHIP FOR THIRTY-TWO YEARS

INVESTIGATE Tannewitz DI-SAWS and You'll Want No Other!



● A broad statement? Yes. But soundly founded on facts—the experience of numerous large manufacturers—the actual performance records of the machines, themselves—and fundamental superiorities of design and construction.

Larger wheels (24" diameter on the standard models) provide greater traction, faster, straighter cutting, more production. Transmissions, common source of the saw grief, never fail in TANNEWITZ DI SAWS. Sturdier, heavier construction throughout, plus many refinements of design, make these machines the greatest, trouble-free producers in their field. It pays to buy the best!

With a TANNEWITZ DI-SAW you can do in minutes jobs which require hours by the shaper, miller or lathe methods.

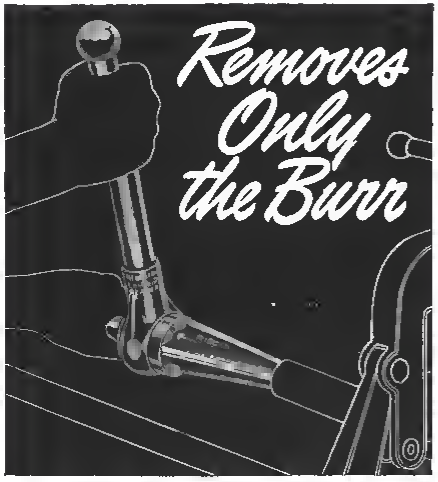
Get the complete facts. Just write for DI-SAW bulletin. Other Bulletins on request: "Single and Variable Speed Foundry Band Saws", Sheet Metal Cutting Band Saws".

STANDARD MODEL No. M 24
(24" WHEELS)

Other Models to Handle Work of Practically Any Size

Made with 30", 36", 48" and even larger throat capacities if desired, the TANNEWITZ "Big Berths" models make available the tremendous savings of inside and outside sawing, filing and polishing on dies, jigs and other work of practically any size. Write for bulletin.

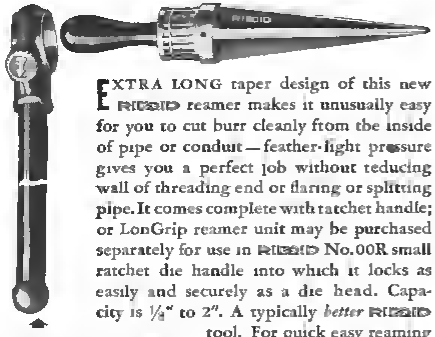
THE TANNEWITZ WORKS, GRAND RAPIDS, MICHIGAN





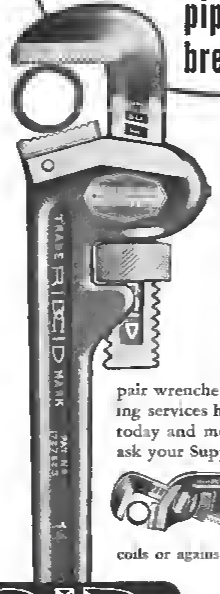
Work-saver
RIGID
is your defense against pipe wrench breakdown

New RIGID Extra-Long-Tapered Reamer



EXTRA LONG taper design of this new RIGID reamer makes it unusually easy for you to cut burr cleanly from the inside of pipe or conduit—feather-light pressure gives you a perfect job without reducing wall of threading end or flaring or splitting pipe. It comes complete with ratchet handle; or LonGrip reamer unit may be purchased separately for use in RIGID No. 00R small ratchet die handle into which it locks as easily and securely as a die head. Capacity is ⅛" to 2". A typically *better* RIGID tool. For quick easy reaming without risk of damaging the pipe, ask your Supply House today for this new *extra-long-taper* LonGrip Reamer.

If you already have a RIGID No. 00R Ratchet Threader all you need to buy is the LonGrip Reamer unit—it works perfectly in the 00R ratchet handle.



THE unique advantage of this RIGID wrench becomes more valuable the further around the fighting globe it goes from sources of replacement and repair. For that guaranteed housing means it won't break or warp, it keeps on working! No binding of hookjaw or of adjusting nut in its wide open housing. But you haven't any more time to repair wrenches these days than the fighting services have. For delay-proof tools today and money-saving tomorrow . . . ask your Supply House for the RIGID



Same failure-proof RIGID quality in this End Pattern for hard-to-get-at pipes in coils or against flat surfaces. Sizes 6" to 36".

Buy RIGID Pipe Tools at Supply Houses Everywhere

RIGID
★ PIPE TOOLS ★

THE RIDGE TOOL COMPANY
ELYRIA, OHIO, U.S.A.

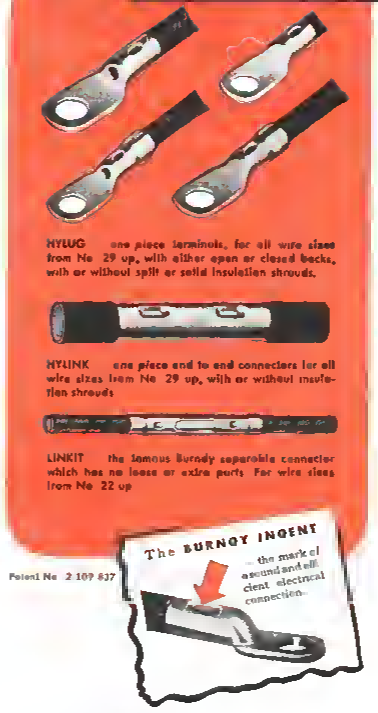


Fast-Working Tools for War . . . and the Busy Peace That's Coming



compactness

makes Burndy HYLINE Connectors space savers . . time savers, too!



For crowded locations, HYLUGS are real space savers due to their shorter barrel, and more compact overall design. They're *time savers*, too, because this virtue simplifies and speeds up assemblies. Despite their extreme compactness, however, HYLUGS are *stronger mechanically*, and more *efficient* electrically . . . because they are formed from pure copper, in one piece Burndy's exclusive *forming* process imparts *high strength*, and one-piece construction eliminates the hazards of extra contact surfaces. HYLUGS and other HYLINE connectors are fully described in the new HYLINE catalog. Write for your copy now.

BURNDY ENGINEERING COMPANY, INC.

BURNDY electrical connectors

107 EASTERN BOULEVARD, NEW YORK 54, N. Y.

Jury of Advertising Men in INDUSTRIAL MARKETING Competition for Editorial Achievement votes:

Triple Recognition of AVIATION'S Editorial Leadership

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L. P. Meyer, Ad. Mgr. Lamp Division of General Electric Co.



Harold S. Oswald, Walker & Downing



"For an outstanding article published during the twelve months ending July 31, 1943 in the Sixth Annual Competition conducted by INDUSTRIAL MARKETING."

"Design Analysis of the Bell Airacobra from Cannon to Tail" in the May, 1943 issue of *Aviation* was one of the most comprehensive articles ever published in a single issue of a trade publication. Editors of *Aviation* devoted months of intensive study and work in collaboration with Bell Aircraft engineers in the preparation of this veritable aircraft engineers' handbook. The thirty page story contained 70 illustrations, including 42 three dimensional perspective sketches treating each of the principal subassemblies of the P-39 in detail. 28,000 requested reprints were distributed and *Aviation's* editorial offices were swamped with letters of appreciation from aircraft executives.



"For a single issue of special purpose published during the twelve months ending July 31, 1943 in the Sixth Annual Competition conducted by INDUSTRIAL MARKETING."

The Tenth Annual Yearbook Number of *Aviation* met a greatly increased need for basic aeronautical working information. Within its covers was published a comprehensive exhibit of U. S. and foreign aircraft and engines, with specifications—directories of key personnel of aircraft, glider, and engine manufacturers, U. S. airlines, aviation schools and a list of some 2200 suppliers to the industry—plus an important and valuable section on aircraft recognition.

The important nature of the information in this issue was fully reviewed and approved for publication by U. S. military authorities.



"For improvement in format and appearance made during the twelve months ending July 31, 1943 in the Sixth Annual Competition conducted by INDUSTRIAL MARKETING."

The year's improvements in appearance and format recognized by *Industrial Marketing* judges, were but part of a long-range program of improvement in the presentation of *Aviation's* subject matter to its readers. Clarity and simplification for speed of reading become especially important in a magazine which has the executive readership of *Aviation*. To serve busy aeronautical executives, *Aviation's* editors and designers constantly strive to simplify and improve the visual presentation of its important working information. To readers and advertisers alike, this achieves a definite advantage in the use and value of the magazine.

CRITICAL JUDGES of magazine editorial value are the seven men pictured above . . . the Jury in *Industrial Marketing's* Sixth Annual Competition for Editorial Achievement open to all business papers of U. S. and Canada.

Editorial substance is of paramount consideration in their daily work—for in the last analysis, it is the prime yardstick of the value of a magazine to its readers, and thus of course to its advertisers.

It is significant that with 290 entries competing for 19 awards, *Aviation* was selected for three separate Awards of Merit. (In the history of this competition only once before has a single magazine won three awards in the same year.) It is also significant that *Aviation* was the only aeronautical publication cited.

To present this kind of editorial material, *Aviation's* editors traveled in the last 12 months over 125,000 miles to uncover stories, go to their sources and dig them out. *Aviation* spares neither time, nor men, nor money to keep its editors in the places and on the projects where aeronautical progress is being made. To implement this editorial policy, *Aviation* maintains the largest full-time editorial staff of aeronautical specialists in the field—maintains editorial offices in seven key cities from Los Angeles to Long Island, with editors and correspondents located in strategic centers throughout the world.

As a result of this month-in-and-month-out high editorial standard and its value to *Aviation's* influential buying audience, advertisers invest more dollars in *Aviation* than in any other aeronautical magazine.

AVIATION

Companion magazine to

Aviation News and Air Transport

McGRAW-HILL PUBLISHING CO., INC.,

330 West 42d Street, New York 18, New York.



Branch Offices • BOSTON—1427 Statler Bldg. • PHILADELPHIA—16 S. Broad Street • CLEVELAND—1510 Hanna Bldg. • DETROIT—2-144 General Motors Bldg. • CHICAGO—520 N. Michigan Ave. • ST. LOUIS—Continental Bldg. • ATLANTA—1011 Rhodes-Haverty Bldg. • LOS ANGELES—601 W. Fifth St. • SAN FRANCISCO—68 Post Street

SCR-299

RIDES THE CREST OF THE INVASION WAVE!

To our troops fighting on all fronts, the SCR-299 Mobile Radio Communications unit is a familiar sight. It helped pave the way for the Allies in Africa and Sicily. In Africa alone it operated on five networks, including circuits from Oran to England, Casablanca, Gibraltar, Algiers and Accra.

Whether set up as a fixed radio station or used as a fast-moving mobile unit, the SCR-299 has done an excellent job transmitting commands while in action, no matter how difficult the conditions . . . thus proving that communications systems were adaptable to the "Blitz" tactics of modern warfare.

The World's Largest Exclusive Manufacturers of Short Wave Radio Communications Equipment

the hallicrafters co.

CHICAGO, U. S. A.

BUY MORE BONDS!



*"Was this his face and these the finding eyes that plucked a New World from the rolling seas?"**

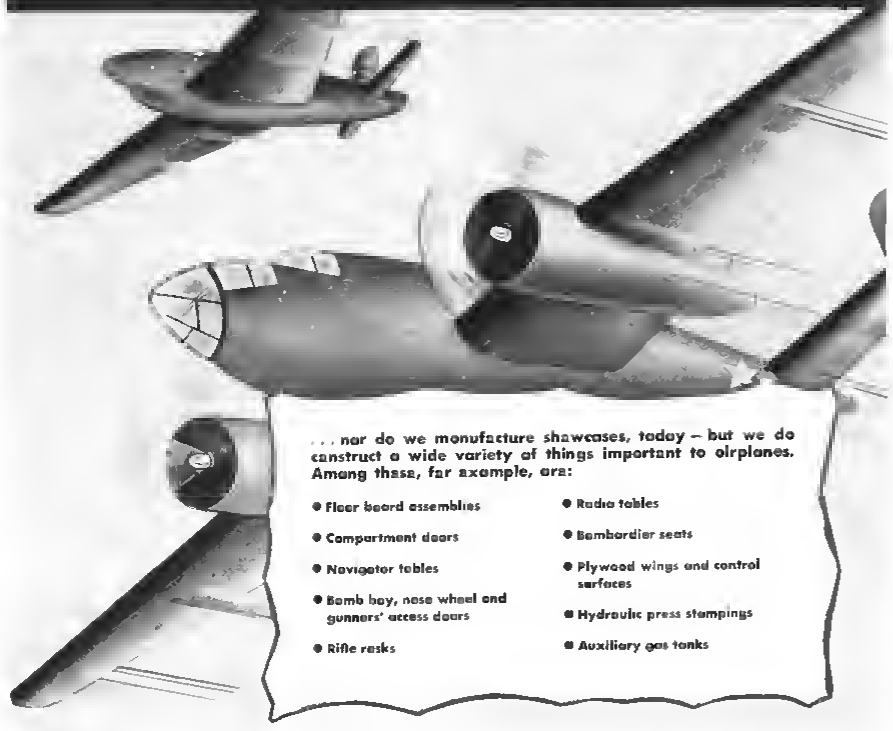


"On A Portrait of Columbus" by George Woodbury

America was conceived in action—determination which recognized no barriers. Columbus knew poverty and patience and ridicule and incredulity before success. Such was the tradition of America. What historical event can match it? A new world—history to change history! Pythagoras analyzed it. Plato chronicled it. Aristotle confirmed it. Dante immortalized it. But Columbus did it. The soul of America's discoverer is reflected in its leaders. Patrick Henry, George Washington, Benjamin Franklin, Abraham Lincoln, John Pershing, Douglas MacArthur and a host of gallant sons perpetuate the memory of their glorious Father. For he it was who gave them this great land for which they fought . . . America.

E. A. LABORATORIES, INC. BROOKLYN, N. Y.
Makers of Aircraft, Automotive and Marine Appliances

WARPLANES DON'T CARRY SHOWCASES, of Course . . .



. . . nor do we manufacture showcases, today – but we do construct a wide variety of things important to airplanes. Among these, for example, are:

- Floor board assemblies
- Compartment doors
- Navigator tables
- Bomb bay, nose wheel and gunners' access doors
- Rifle racks
- Radio tables
- Bombardier seats
- Plywood wings and control surfaces
- Hydraulic press stampings
- Auxiliary gas tanks

ONE OR MORE of these items is flying on many a U. S. headline-making airplane—fighters, bombers, cargoes and transports. The Aircraft Division at Weber is a flexible organization set up to meet efficiently the varied production demands of the plane manufacturers it serves. It is well equipped in facilities and experience to solve many special manufacturing problems in metal, wood or glass. Our engineers are here to serve you—write or wire today for their solutions to your specific problems.

WEBER FACILITIES & EXPERIENCE "WORKING FOR VICTORY"

AIRCRAFT DIVISION

WEBER SHOWCASE & FIXTURE CO. INC., 5700 AVALON BLVD., LOS ANGELES, CALIF. • EST. 189?



VARIETY IN TRIM TAB CONTROL GEAR BOXES

Air Associates designs and manufactures various types of precision gear boxes for tab controls and other similar applications. All of these are engineered for high mechanical efficiency . . . Several designs utilize small, precision-cut spiral bevel gears on ball-bearing shafts, but gear boxes can also be furnished with spiral gears and plain bearings or ball-and-roller bearing combinations . . . Special designs can also be supplied to meet special requirements. *Present schedules permit acceptance of additional orders for delivery in the first quarter of 1944* . . . Gear boxes are but one of many dependable products that Air Associates engineers and manufactures . . . or supplies to the aircraft industry.

AIR ASSOCIATES, INC.

TETERBORO, N. J. *BRANCHES* CHICAGO, DALLAS, LOS ANGELES . . . ENGINEERS & MANUFACTURERS OF AIRCRAFT SPECIALTIES . . . SUPPLIERS OF ALL TYPES OF MATERIALS TO THE INDUSTRY SINCE 1927



Smoothness—

that puts horsepower "back in harness"



ROUGH FINISHES have a way of acting as horse thieves—they steal horsepower and subtract from a plane's performance. The fact that government specifications have been followed—and inspection tests passed—is no guarantee against this power-consuming roughness.

Thanks to long experience in the industrial field, Pittsburgh technical men have been able to develop camouflage finishes of extraordinary smoothness. They reduce wind resistance to a minimum—help the plane to cash in on all the horsepower the engines can generate. These super-smooth finishes are a typical Pittsburgh achievement. In every one of our wartime formulations, we endeavor to put *plus*-over-minimum requirements.

Free Advisory Service. Pittsburgh maintains a force of "trouble shooters"—experts whose specialty is solving aircraft finishing problems. Whenever you need help, get in touch with us. One of our technical men is available for consultation.

PITTSBURGH PLATE GLASS COMPANY, Industrial Paint Division, Pittsburgh, Pa. Factories: Milwaukee, Wis., Newark, N. J., Houston, Texas, Los Angeles, Calif., Portland, Ore. Didder Color Division, Detroit, Mich. The Thresher Varnish Co., Dayton, O.

PITTSBURGH *Industrial* **FINISHES**

PITTSBURGH STANDS FOR QUALITY PAINT AND GLASS





Official U S. Navy Photo

Inside Stuff . . .

Sparton won't tell anything that would be harmful to our boys in the service

Each time we are commended by the Allied Forces for the workings of our products in action, we are spurred to greater production

Humbly, our chests swell with pride . . . for these are being operated by our sons, our neighbor's sons heroes, every last one.

Today, Sparton is building 14 major products for the Allied Forces Horns, sirens and warning signals of every type for motor cars, tanks, trucks, jeeps, planes and ships.

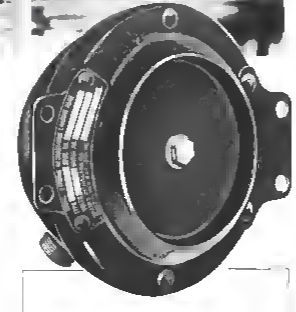
Bomb hoists and releases Airplane mooring kits Aluminum tanks for bombers.

Communicatory systems for use on land, at sea and in the air After victory you can expect great surprises from Sparton Finer horns and signalling devices. Other new and better products for the automotive, marine and aviation fields

PLAN AHEAD WITH SPARTON — We invite inquiries with others who are interested in post war marketing opportunities in which our 43 years experience in electrical precision manufacture can be invaluable

SPARTON

PRECISION ELECTRICAL MANUFACTURERS SINCE 1900



SPARTON
LANDING GEAR SIGNAL

Designed for use in retractable landing gear equipped planes This is but one of major precision built instruments that flow in endless streams from Sparton plants to help speed the day of victory

THE SPARKS-WITHINGTON COMPANY
PLANT 1, JACKSON, MICHIGAN

Planes of Tomorrow
No 1 Courtesy of United Air Lines





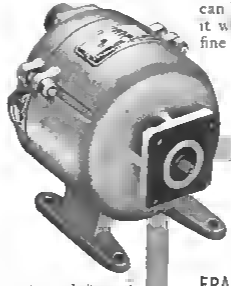
Automatic controls in this plane require 100 SMALL ELECTRIC MOTORS

Cargo and passenger planes of huge size are no longer a dream of the scientific writers. Present-day engineering advances, many of them covered with a cloak of wartime secrecy, make such planes entirely feasible when the men and materials are available to build them.

Small electric accessory motors will play a big part in operating the superplanes of tomorrow, just as they do in thousands of military aircraft today. You'll find them operating wing flaps, trim tabs, and many other controls which can hardly be operated by hand. The bigger the plane, the more small motors it will need. Bodine motors, now widely used in military planes, will have a fine background of experience for post-war applications.

Bodine Has Been Supplying Industry with Quality Fractional Horsepower Motors for Over 35 Years

Bodine Electric Company, 2274 W Ohio Street, Chicago 12, Illinois



Bodine motors are built to meet or exceed Air Force specifications

BODINE

FRACTIONAL HORSEPOWER MOTORS FOR AIRCRAFT ACCESSORIES



FLYING'S toughest test—the power dive—is "duck soup" for the new Automatic Electric Class 'S" Relays. Their sturdy construction is proof against the most terrific vibration that modern flying can set up

Class "S' Relays have been designed with aircraft requirements especially in mind. Small in size, light in weight, but packed with power, they offer a combination of features never before found on any relay, large or small. For example

1.—Vibration resistance is designed into Class "S' Relays—not "added on' They withstand with a large margin of safety the most rigorous operating tests required by the Signal Corps and the Air Forces.

2.—A unique spring design provides high contact pressure within small space limits.

3.—Additional safeguards are provided by independent self-cleaning twin contacts.

4.—A new type of pin-pivoted armature with full-length bearing provides exceptionally long life under severe service conditions

Why not get the whole story about Class 'S' Relays? Write for engineering data giving full specifications of these and other Automatic Electric Control apparatus.

AUTOMATIC ELECTRIC SALES CORPORATION
1033 West Van Buren St. Chicago, Ill
In Canada: Automatic Electric (Canada) Limited, Toronto



Class "S" Relay—Single Arm



Class "S" Relay—Double Arm

Class "S" Relays are available with a wide variety of coil and contact combinations and operate and release speeds. The single arm relay has a capacity of six contact springs—the double arm, twelve springs. Springs may be provided in any combination and arrangement of "break" "make' or "break-make" assemblies •

Relays
AND OTHER CONTROL DEVICES
by **AUTOMATIC ELECTRIC**

PARTS AND ASSEMBLIES FOR EVERY ELECTRICAL CONTROL NEED



When you see planes of the U. S. Army in the sky you may not know where they are going. But you can be sure where they started. The flight started from the breaking of Tri-Sure seals—and filling the tanks with the good gasoline those seals have protected from rain, dust and sabotage.

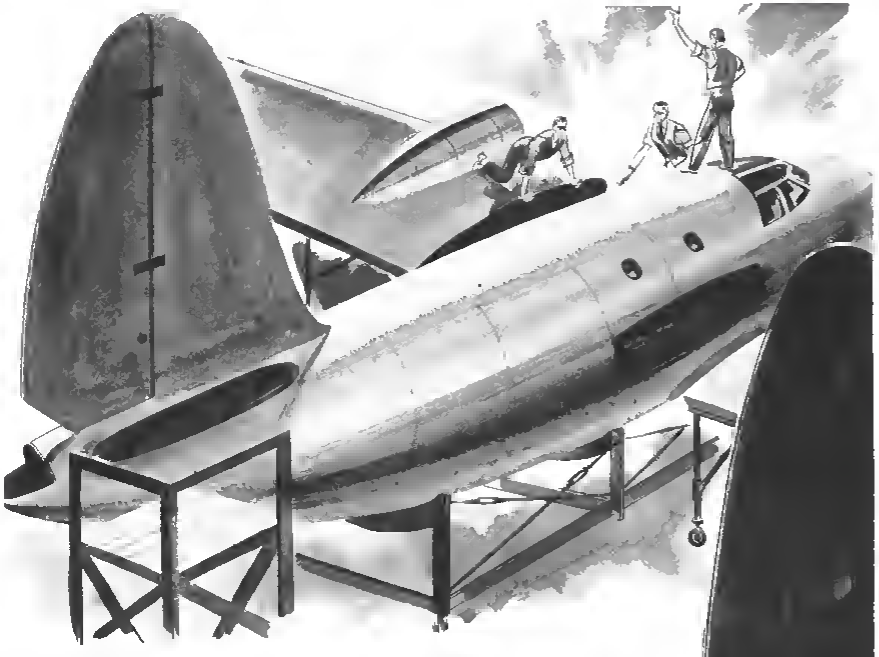
Today, Tri-Sure Closures are as vital to drums as modern armor is to planes. For, no matter how far drums are shipped, or how long they are stored, when Tri-Sure Closures are on guard you know the gas is as good as it was the day the drums were filled.

Wherever planes are flown or tested, Tri-Sure Closures are the first step to safe, top-notch performance. To make *sure* you receive every drop of the gas or oil you order, to make *sure* it will be at its best in every test, when ordering gas or oil always specify "in Tri-Sure-fitted drums."

AMERICAN FLANGE & MANUFACTURING CO. INC., 30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.
TRI-SURE PRODUCTS LIMITED, ST. CATHARINES, ONTARIO, CANADA

Tri-Sure
CLOSURES

PROTECT THE FUEL THAT KEEPS 'EM FLYING — SAFEGUARD YOUR DRUMS AND KEEP 'EM ROLLING

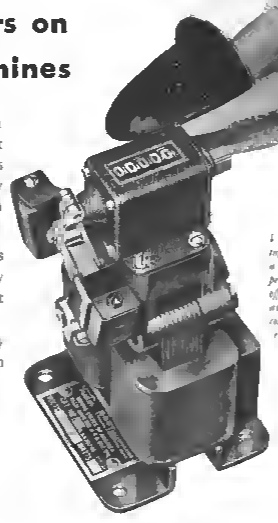


PUT WINGS ON PRODUCTION

...put Veeder-Root Counters on all YOUR production machines

Planes and motor parts and sub-assemblies keep their dates with each other *right on the dot* — when each production machine is kept in step with Veeder-Root Control By Count. In fact, production flies faster than ever when set free from delays and shortages caused by guesswork, miscounts and lack of a continuous visual check on whether machines are running at scheduled rates.

This check can be provided by one of the scores of different types of Veeder-Root Counting Devices, either mechanically or electrically operated. These devices are inexpensive — simple to install without disturbing production — compact — easy to read in any terms: turns, strokes, pieces, trips, lengths, volumes, light flashes, or any other unit of performance. Find out exactly how these devices can step up *your* production tempo — drop a line in the mail today.



Veeder-Root Remote Indicating Magnetic Counter flasher: a running report of machine performance from plant to office no matter how far away. Any number of these counters can be grouped on a centrally located board.

VEEDER-ROOT INC.

HARTFORD 2, CONN., U. S. A.



Even the Big Inch Needs IRC RESISTORS

Vital arteries of supply in this mechanized war are America's pipelines. To maintain capacity flow, sludge and gummy deposits must be cleaned out at intervals. For this purpose a screw-type scraper propelled by the oil pressure is employed. When occasionally the scraper becomes stuck and plugs the line, the point of stoppage must be located to release the flowing oil.

ANOTHER IRC DEVELOPMENT

But where—and how?

With the use of the Geiger-Mueller Counter, hours—and sometimes days—of search are saved. Modern scrapers contain radio active metal which constantly emits an impulse message. When trouble occurs, these signals are picked up by the Counter, as the line is checked. At the point of greatest intensity the pipeline is tapped and the obstruction cleared away.

IRC engineering ingenuity plays an important part in the functioning of Geiger-Mueller Counters. Many specially designed IRC resistors and controls are employed in their carefully adjusted circuits.

If you have a design or engineering problem involving resistance units and you are seeking unbiased advice, why not come to Resistor headquarters at IRC? We make more types of resistors, in more sizes, for more applications than any other manufacturer in the world.

PREFERRED FOR PERFORMANCE — IRC — FIXED & VARIABLE RESISTORS

INTERNATIONAL RESISTANCE COMPANY

Dept. C 401 N. BROAD STREET • PHILADELPHIA 8, PA.

SNAGGING WHEELS "Built to Take it!"



Here are honest to goodness reasons why BAY STATE WHEELS last longer and produce a lower grinding cost per ton

1. CONTROLLED POROSITY (Control over the size and distribution of pore spaces between abrasive particles.) — Cooler cut, increased wheel life, closer duplication.
2. RESINOID B BOND (Specially designed for *High Speed* operation) — Greater ability to resist heat
3. VITRIFIED H9 BOND (To be used where "A" abrasive (Aluminum Oxide) products are required) — A tougher, sturdier bond for severe, *Slow Speed* operations.
4. VITRIFIED B BOND (Used exclusively with "C" abrasive (Silicon Carbide) — A sharp, cooler cutting wheel for snagging cast iron and low tensile strength materials.

Send for Bulletin on this subject

BAY STATE
ABRASIVE PRODUCTS CO., WESTBORO, MASS. U.S.A.



case history of a Grouser Stud

A "Grouser Stud" is a tough little customer about 2½" long and not particularly glamorous—but it does a big job. This stud holds secure the raised metal driving cleats on a tank's tread into which the sprockets bite. When Allied Products Corporation was asked to study production of these studs, we adopted our typical attitude: "Is there a better way to do it?"

Our engineers found there was. By simplifying design two operations were eliminated; by cold-heading the part and rolling the threads, important quantities of steel formerly removed in machining, were saved.

When the record of a successful war is written, it will certainly reflect the importance of such unheralded attention to the detail of vital "little things" on whose performance battles hinge.

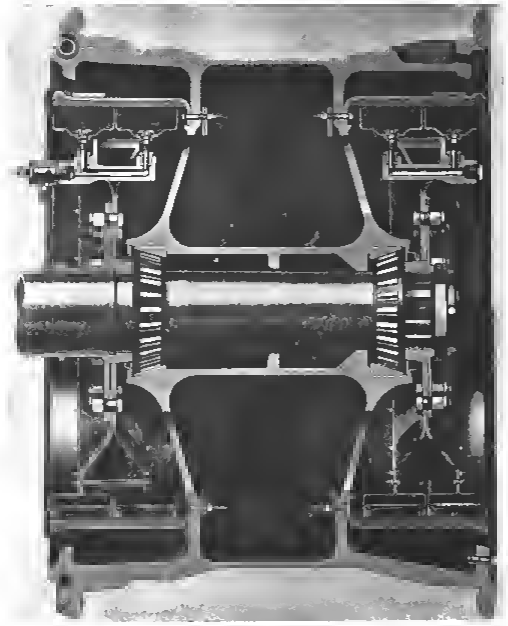
ALLIED PRODUCTS
CORPORATION
DETROIT AND HILLSDALE, MICHIGAN

"IT'S AN ALLIED PRODUCT!"

The studs described above were produced by Victor Peninsular Division of Allied Products Corp. Three other plants of the Corporation are producing precision aircraft parts, punches and dies, plastic molds and many other specialized products.

We are proud that each of our four plants flies the Army-Navy "E" for Excellence.

IT'S THE "WHO" THAT COUNTS...



ALONG WITH THE "KNOW HOW"

STOPPING aircraft after landing is our job. Building the wheels and brakes to do that job is our business.

Hollerith design and Hayes manufacture have pioneered in the aircraft field — civil and military — for mechanical, hydraulic and Expander Tube Brakes.

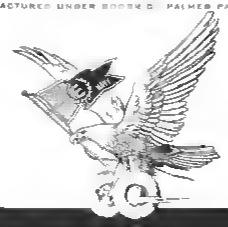
Every Expander Tube Brake on American bombers and other craft is a Hayes' product.* All U. S. four-engine bombers in production today are equipped with Hayes Wheels and Expander Tube Brakes.

Higher landing speeds and increased weights, today and those projected, are planned for and met with research and performance.

The airframes, the engines, the tires and other parts are the specialized concern of makers in their own fields. ***The wheels and brakes, designed to fit the static and dynamic problems, are the specialized concern of a wheel and brake manufacturer.*** In wheel manufacturing, Hayes has led for 50 years.

That's why the "who" counts, along with the "know how" — when it comes to accurate ground control, operating economy and easy maintenance.

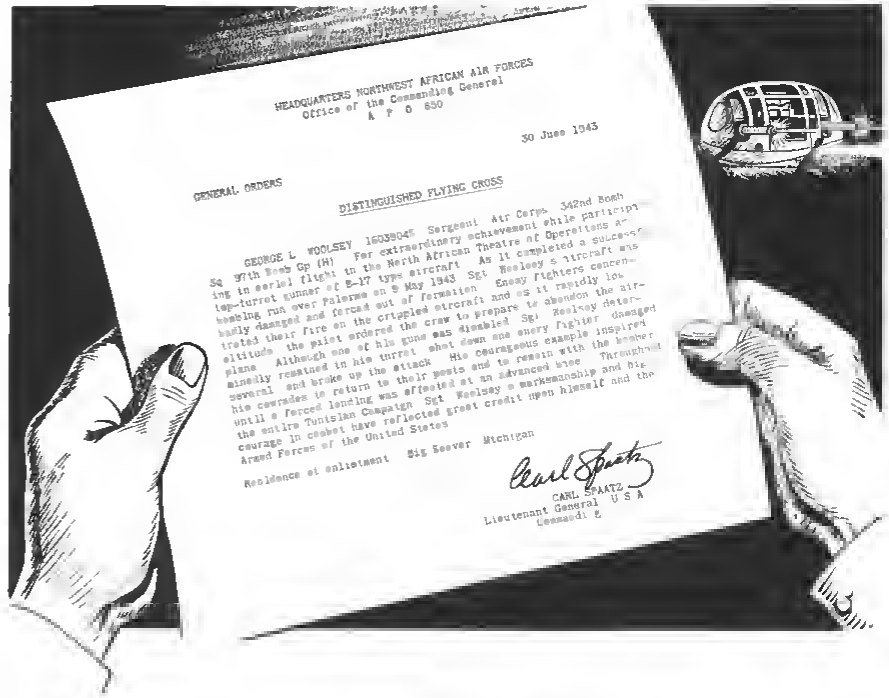
* MANUFACTURED UNDER BOOTH & PALMER PATENTS



HAYES
AIRCRAFT WHEELS AND BRAKES

Western Representative: Airsupply Co., 5959 W. 3rd St., Los Angeles
Eastern Representative: J. Henry Reisner, Hagerstown, Md.

HAYES INDUSTRIES, INC. Home Office: JACKSON, MICHIGAN, U. S. A.



George Got Word of His Kid the Other Day



You all know George—you'll find his counterpart in every war plant. He's the quiet, steady fellow who assumes the most hazardous part of every war job—that's George.

In our plant, George is a powder mixer and to see him confidently but carefully rumbling those highly volatile charges which go to make up the world's most powerful photoflash bomb, you'd never believe George had a worry in the world.

But he has, for you see George has a kid—that is, he seemed just a kid until that day he came home and told his "old man" he'd enlisted in the Air Corps. That's when George began to worry.

Yet there was no hiding his pride when the kid turned out to be a gunner—and on a B-17 at that—still that was only as it should be—hadn't the kid been one of the best wing shots in the field? Still George couldn't help but worry—for he knew there was quite a difference between knocking Messerschmidts out of the sky at 300 per and shooting pheasants on the wing.

Well, George got word of his kid the other day—got a letter from the kid's boss—learned what a swell job the kid's doing. You can imagine how pleased and proud George was . . . and so were we . . . he's George's kid.

Being close to George has made us realize more than ever that it's men like him on the home front and their kids out there on the war fronts who will win this war. The least we can do to help is to hasten the day when George and his kid will be together again.

Until that day, our only consideration is helping to arm our Nation and its Allies. We are doing that to the best of our ability making round-the-clock quantity deliveries not only of military pyrotechnics and aircraft assemblies but by helping other war plants increase their production with McAleer *quality-controlled* finishing materials and methods. What can we do to help YOU in your war effort?

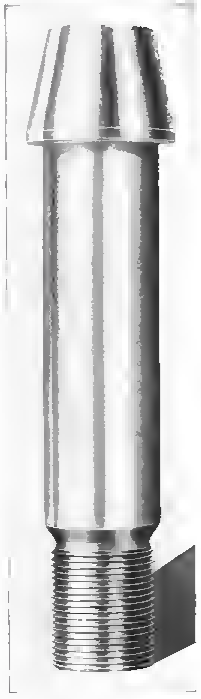
McAleer MANUFACTURING CO. ROCHESTER, MICHIGAN

Manufacturers of Quality Controlled Finishing Materials Military Aircraft Sub-assemblies and Pyrotechnics.

HOLO-KROME

Internal HEX Wrenching BOLTS

TO NASC SPECIFICATIONS AND TO SPECIAL DESIGN



MOTOR MOUNT



STANDARD NASC



SPECIAL WING TIP



SPECIAL WING ATTACHMENT



SPECIAL LANDING GEAR

FASTENING PROBLEMS...

The necessity of change in design, to meet new conditions, creetes festening problems that are being successfully met today, with Internel Hex Wrenching Bolts.

HOLO-KROME devotes its antire fecilities, exclusivaly, to tha menufecture of Internal Wrenching Hex Socket Screw and Bolt Products.

Assisting you in solving your fastening problems is the business of Holo-Kroma Fastaning Engineers—feel free to consult them.

AIRCRAFT CATALOG

Write Dept. A4
for Your Copy



AIRCRAFT DIVISION — THE HOLO-KROME SCREW CORP., HARTFORD 10, CONN., U. S. A.



A change in the scale calibration [illegible] but from the standpoint of instrument design, and *instrument dependability*, these familiar WESTONS are counterparts of the instruments which have been the accepted measurement standards of science and industry for over half a century

The complete line of WESTONS for aircraft service includes Electrical Tachometers (both AC and DC types) Synchroscopes Single and dual type Carburetor Thermometers Oil Thermometers Cylinder Temperature Thermometers Fuel Air Ratio Indicators Cabin Thermometers Outside Air Thermometers Radio Compass Indicators Blind Landing Indicators Ammeters Voltmeters Volt Ammeters Frequency Meters Weston Electrical Instrument Corp., 616 Frelinghuysen Avenue, Newark 5 New Jersey

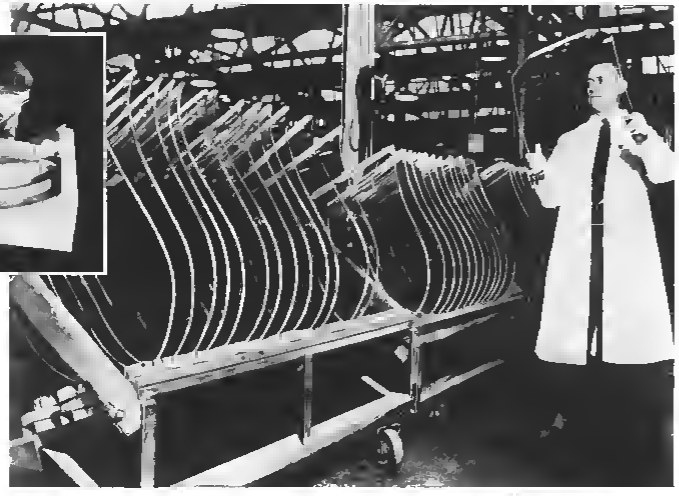
WESTON

Aircraft Instruments

Another L·O·F WARTIME CONTRIBUTION...

CURVED AIRCRAFT GLASS





• Highly skilled workmen are required to cut curved Safety Plate Glass for aircraft

• Inspecting curved laminated aircraft Safety Plate Glass. New bending techniques have been developed to meet the requirements of the aircraft industry

Top quality materials, skilled craftsmen and ample facilities are three qualifications which Libbey-Owens-Ford Glass Company daily employs in its plants.

Today, in one phase of its war work, Libbey-Owens-Ford is meeting successfully the demands for aircraft Safety Plate Glass possessing greatly increased strength and curved to extreme shapes, as well as for new constructions which simplify installation in plane openings. The new installation methods provide added flexibility and strength in service, thus reducing glass breakage due to impact and strain. They also permit flush surfaces, decreasing wind resistance at all levels of flight and discouraging ice formation by eliminating ledges on which ice might accumulate.

Its capacity for volume production by thoroughly skilled workers, plus the know-how obtained from over a quarter of a century's experience in making glass for thousands of uses, have enabled Libbey-Owens-Ford to make many contributions to the manufacture of military equipment—in the air, on land and on the sea.

From our Engineering and Research Laboratories have come many developments for both wartime and peacetime use. At all times we welcome the opportunity to co-operate with aircraft and allied manufacturers in supplying technical assistance. Libbey-Owens-Ford Glass Company, 74103 Nicholas Building, Toledo 3, Ohio

LIBBEY·OWENS·FORD
A GREAT NAME IN *Glass*

800 Pictures on Carburetor Maintenance

In Slide Films and Book



Visual education is a vital part of our war program. Many training centers are finding these two new Holley educational aids essential in their carburetor instruction work.

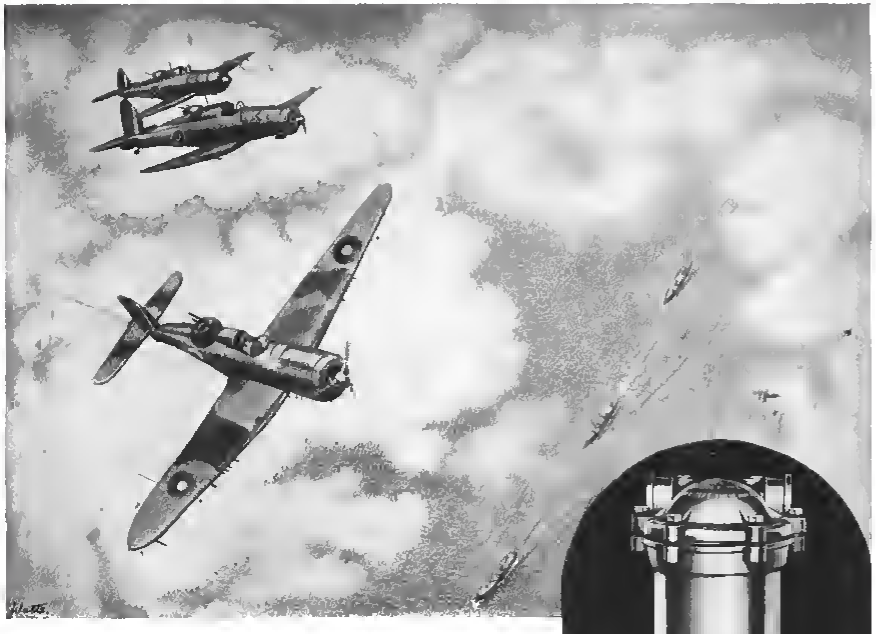
This material is available in two forms . . . in a series of eleven 35-mm. strip slide films, and in a 96-page book for review purposes.

This film library and book both contain the some illustrations and descriptive matter . . . complete information on every detail of Holley Aircraft Corburetor operation and servicing.

Write for further information.

HOLLEY CARBURETOR CO.
DETROIT, MICHIGAN

HOLLEY
AVIATION CARBURETORS



LOOKING FOR TROUBLE

TO keep the Allies' supply lines open, to enable us to dispose men, munitions and food where they are wanted, demands utmost efficiency to the last detail.

Aircraft looking for trouble and ready to destroy the menace that comes from under the sea, ships, guided by men ceaseless in their vigilance, dodging this trouble, all are dependent on the absolute reliability of engines both in aircraft and ships.

The job of work Vokes Filters have to do is to ensure that the air, oil and fuel oil servicing engines is free from impurities so that maximum power and speed and complete dependability can be assured. Vokes Filters, under the severest battle conditions in all areas of fighting on land, sea and in the air, have stood up to demands made on them. Exacting tests to nearly three years of war in all branches of the services has substantiated the claim for Vokes Filters —99.9 per cent. FILTRATION EFFICIENCY UNDER ALL CONDITIONS.



TOP—VOKES OIL FILTER FOR AIRCRAFT CONTINUOUSLY REMOVES ALL IMPURITIES TO 0·00004 IN DIA RESISTANCE NEGLIGIBLE. NO INTERRUPTION OF OIL CIRCULATING

BOTTOM—VOKES AIR FILTER FOR AERO ENGINES STANDARD TYPE FOR MOST FIGHTING AIRCRAFT

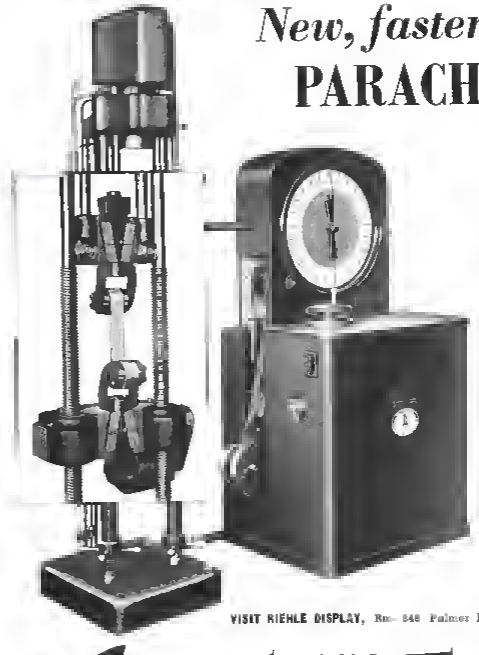
VOKES

VOKES LIMITED · FILTRATION EXPERTS

THE ARTHUR S. LEITCH CO. LTD.
1123 BAY STREET, TORONTO, CANADA
E. CANTIN 101 PARK AVE., NEW YORK



New, faster method of testing PARACHUTE WEBBING



THIS PRECISION hydraulic testing machine has been designed especially for testing parachute webbing economically and accurately. High speed pulling head plus newly designed and quickly applied grips enable as many as 60 tests per hour. Accuracy and reliability are assured. All breaking loads are measured by *gravity stress* acting on a pendulum. There are no metallic parts in the weighing mechanism subject to changing characteristics from metal fatigue.

Maximum loading capacity is 10,000 pounds. Load tests as low as 60 pounds are registered accurately. *Write for details and delivery schedule*

"It's REALLY tested when it's RIEHLE tested"

VISIT RIEHLE DISPLAY, Rm. 848 Palmer House, National Metal Congress War Conference Display, Oct. 18-22

RIEHLE *HYDRAULIC PENDULUM TESTING MACHINES*

Division of American Machine and Metals, Inc.
EAST MOLINE, ILLINOIS

HOUDRY UNITS NOW IN OPERATION	HOUDRY AND T.C.C. UNITS NOW BEING BUILT	TOTAL NUMBER OF HOUDRY-LICENSED UNITS
20	+ 39	= 59

It all adds up to this:

Most of America's catalytic aviation gas program depends on Houdry Processes

If you like to speculate on catastrophes that didn't happen, just try to figure out how we would stand in the war today if it hadn't been for catalytic cracking. Our now mighty arm of air power might have been puny indeed. For we could never have approached the quality and quantity of our present production of high-octane aviation gasoline.

Fortunately for America and the world, the famous Houdry Catalytic Process was already in successful operation long before Pearl Harbor. Within a few months, Houdry units were converted to the manufacture of aviation base stock. Many additional units were under construction. Now, as America enters its twenty-first month of war, 90% of *all* catalytically cracked aviation gas has been produced by the Houdry Process. Thanks in large part to the Houdry Process, the United Nations have had *enough* and *on time!*

Today there are 20 Houdry Static Catalyst units operating and 10 building. Soon the first of 29 T.C.C. units will go on stream. Altogether, 59 Houdry-licensed catalytic units are in operation or under construction. They will bear proudly the burden of producing most of the world's needs for catalytically cracked aviation fuel to destroy the Axis.

Houdry Catalytic Processes and the Thermofor Catalytic Cracking Process are available to all American refiners, under license arrangements, subject to approval by the United States Government.

HOUDRY PROCESS CORPORATION, Wilmington, Delaware

Licensing Agents—

E. B. BADGER & SONS CO
Boston, Massachusetts

BECHTEL-McCONE-PARSONS CORP
Los Angeles, California

THE LUMMUS COMPANY
New York City, New York

HOUDRY CATALYTIC PROCESSES
"VICTORY IN WAR, BETTER PROGRESS IN PEACE"



Photos courtesy Lockheed Aircraft Corporation



Belden wire is used on wiring assemblies on Lockheed planes.

ANOTHER PLACE WHERE BELDEN WIRE GOES TO WAR

This new reconnaissance bomber performs wonders on specialized jobs including that of tracking down U-boats. It has won for itself the name "Old Boomerang"—because it always comes back.

Here's another example of the way American ingenuity is defeating dictatorship. Here skilled workers are using service-tested materials in producing weapons that "stay on the job." Here's another place where Belden wire goes to war.

Back of Belden aircraft wire is a lifetime of experimenting and testing and collaboration with aircraft engineers since flying was in its infancy. This vast experience makes possible the Belden aircraft wire that meets today's needs.

Belden Manufacturing Company, 4665 W. Van Buren St., Chicago 44, Illinois

Awarded the U. S. Treasury Special Citation of Merit for initiating the War Bond "Cash Dividend Plan."

Belden *Aircraft* **WIRE**

Starter, Lighting, and Instrument Cables ✓ ✓ ✓ SPARK PLUG WIRES



Pressure Tubing...

stands by to help!

This Technical Service *Is Yours for the Asking*

The Michigan Seamless Tube laboratory is always available for studies to determine what qualities tubes must have for a specific installation, and to specify mill procedure for producing them. Ask this company for such a study of tubing for your product. No obligation, of course.

If pitched into the sea, an American pilot relies on his life raft—and a cylinder made of seamless steel pressure tubing. Attached to the raft and heavily charged with compressed gas, the cylinder is ever ready to inflate the rubber boat in a jiffy.

Pressure tubing for these cylinders is one of many items which Michigan Seamless Tube Company is supplying to the war effort. Michigan facilities today are wholly engaged upon war production; and at Michigan armament contractors find a helpful "know how" based on wide experience in developing and producing tubes to meet special and exacting requirements in many fields.

BACK THE ATTACK ★ ★ BUY WAR BONDS

MICHIGAN TUBING

MICHIGAN SEAMLESS TUBE COMPANY

SOUTH LYON • MICHIGAN

ARMY NAVY E

Awarded Feb 12, 1943



Organized Against the Sabotage of Inadequate Inspection

Magnaflux Service

As originators and pioneers of the Magnaflux Methods, Magnaflux Corporation and its engineering staff have accumulated an unequalled fund of specialized knowledge and experience on this subject. This is placed at the disposal of industry in the service which is extended to Magnaflux users. Included are training for operators, all necessary text books, regular contacts by field engineers, laboratory services, etc.

MAGNAFLUX CORPORATION

Industry has only just emerged from the phase in which *any* inspection was adopted as a remedy for *no* inspection. The high pressure of war production quickly proved such casually adopted methods inadequate—if not downright threatening to the armament program. It has been the part of the Magnaflux Corporation to advance the overall efficiency by offering continuously improved techniques.

Only deliberate organization to maintain a consistent research program can assure this kind of steady development. The Magnaflux Corporation has chosen to specialize in non destructive detection of flaws at whatever point promises greatest savings. On the production line this calls for inspection stations, handling every unit, set up between production of parts and the beginning of assembly. In operating equipment, inspections must be made promptly at the time of periodic overhauls.

Within this closely defined field it has proved possible to offer first, magnetic particle inspection (the basic Magnaflux* Method) for all parts susceptible to magnetism—Then, to add black light inspection of fluorescent magnetic particles (Magnaglo* Method) for magnetic metal parts with darkened or obscured surfaces—Then, to go a step further with black-light fluorescent penetrant inspection of non-magnetic parts (the Zyglo* Method) not only for magnesium alloys, aluminum, bronze, austenitic steels but for ceramics, plastics and solid parts in general.

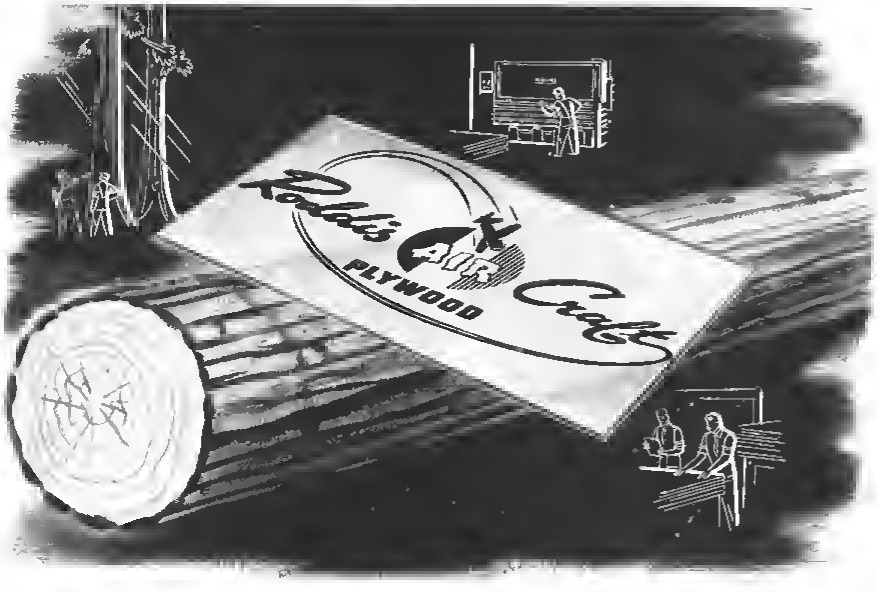
Magnaflux Research with these sound achievements in practical application, presses on to the fuller development of the Science of Non Destructive Flaw Detection.

** Registered Trade Marks covering the methods, materials and equipment of Magnaflux Corporation*

MAGNAFLUX CORPORATION

5906 Northwest Highway, Chicago 31, Ill.

NEW YORK CITY • LOS ANGELES • DALLAS • DETROIT • CLEVELAND • BIRMINGHAM



ONE THING RODDIS REFUSES TO SHARE . . *Responsibility*

It's Roddis all the way in the production of Roddis Aircraft Plywood. From forest to finished product no responsibility for any operation is delegated. Roddis woodsmen select the logs—Roddis craftsmen with a 50 year heritage of "know how" with wood skillfully apply each process in the manufacture of this highly technical product. Six times, Roddis' men inspect each individual sheet of Plywood on its way through the plant. And finally, Roddis stakes its 50-year reputation on every shipment, with the Roddis Bond.

Roddis likewise assumes responsibility for distribution with its own distributing organization. Our warehouses are manned by Roddis men—factory trained—with a complete understanding of wood and its applications, whether it be the simple selection of lumber, or the highly technical application of plywood to planes and gliders. The knowledge and experience of these men, at the following locations, are part of the Roddis complete Wood Service. Feel free to consult them.

RODDIS LUMBER AND VENEER COMPANY
Marshfield Wisconsin

RODDIS COMPANY
1435 W. 37th St., Chicago 9, Ill.

RODDIS LUMBER AND VENEER COMPANY
4601 W. State St., Milwaukee 8, Wis.

RODDIS LUMBER AND VENEER CO. OF MISSOURI
2729 Southwest Blvd., Kansas City 8, Mo.

RODDIS PLYWOOD AND DOOR COMPANY, INC.
15 Carleton St., Cambridge 42, Mass.

RODDIS PLYWOOD AND DOOR COMPANY, INC.
515 W. 36th St., New York City 18, N. Y.

RODDIS LUMBER AND VENEER CO. OF MISSOURI
2615 Lullwat Street, Dallas, Texas

SODDIS LUMBER AND VENEER CO. OF MISSOURI
727 N. Cherry St., San Antonio, Texas

RODDIS PLYWOOD AND DOOR COMPANY, INC.
Review and Greenpoint Avenues
Long Island City, New York

RODDIS PANEL AND DOOR COMPANY
457 E. Sixth St., Cincinnati, Ohio

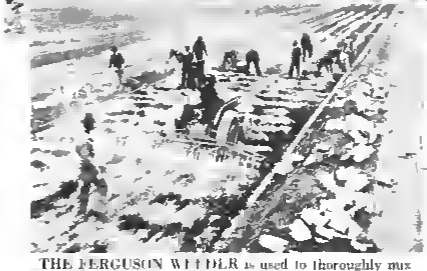
RODDIS PANEL AND DOOR COMPANY
1204 W. Ormsby Ave., Louisville, Ky.

RODDIS LUMBER & VENEER CO.
MARSHFIELD, WISCONSIN

AIRFIELD RUNWAYS *MONTHS QUICKER*

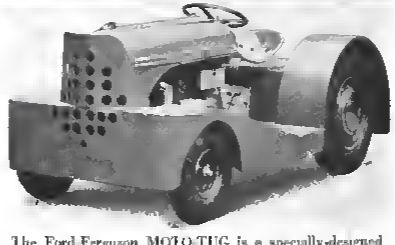
with less material and labor





THE FERGUSON WHEELER is used to thoroughly mix the soil and portland cement.

IMMEDIATE DELIVERY



The Ford-Ferguson MOTO-TUG is a specially-designed power unit to move planes at airports. Built with drawbar pull of 2500 lbs. and 1000 lbs. One unit will handle largest bombers or transports on runway or apron.

Ford MOTO-TUG FERGUSON

The three Ford-Ferguson Tractors with implements shown above, are plowing, tilling and discing an airport runway as the first steps in the soil-cement process of runway construction.

After the soil is pulverized, a carefully determined amount of portland cement is spread, then thoroughly mixed with the soil. Water is added, and the soil-cement mixture is compacted. After a short period of curing, a durable runway is ready for service—well able to withstand the shock from landing and rolling planes.

This quick and practical method is being used on field after field as new runways are urgently needed to meet expanding military needs. The Ford-Ferguson Tractor, with both regular and special implements, is performing many important services in the maintenance and operation of airports. Our engineers will be very glad to discuss equipment to meet specific conditions.

HARRY FERGUSON, INC. • Dearborn, Mich.

Ford Tractor
FERGUSON SYSTEM



Finding the Needle in a North African Haystack

YOU'RE a bomber's nurse in North Africa and you need a new oxygen control valve for your plane. That's one of 250,000 parts in air force stocks.

You'll find it in a few seconds.

When spare parts come to a supply depot, an Addressograph* plate is embossed, giving a complete description of the part, and the number of the bin in which it will be stored. An impression of that plate goes into the depot's stock records, another goes on the bin, another is attached to the part itself. Then when parts are ordered, they can be located and shipped out quickly—and identified anywhere.

You get your bomber into the air quicker and always with the right repair because of an Addressograph plate—the same kind you use in your business to write payrolls, purchase orders and invoices, for tool crib control, or any of the hundred ways Addressograph methods are used.

Years ago Addressographs were employed to address envelopes. They still are, but business men soon began using this quick, always-accurate way of writing information in scores and then hundreds of new ways. Teamed with Addressograph are Multigraph* and Multilith* methods. Together they can make 80% of all paper work of business simpler, faster, more accurate, more economical. We'll prove it in your own case, with equipment you already have. Write or call the Addressograph-Multigraph Corporation—Cleveland and all principal cities of the world.

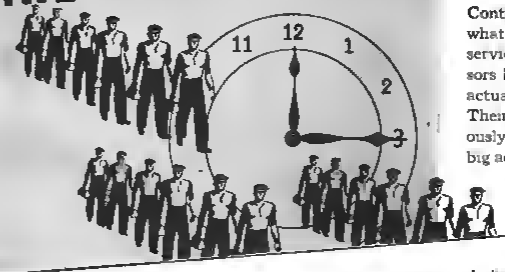
*T.M. Reg. U. S. Pat. Off.

Addressograph

TRADE MARK REG. U.S. PAT. OFF.

SIMPLIFIED BUSINESS METHODS

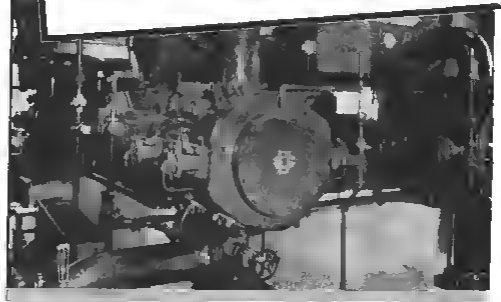
THREE-SHIFT PERFORMANCE...



Continuous, round-the-clock production is what industry wants today. For that kind of service, Gardner-Denver horizontal compressors have established a reputation based on actual operating experience across the land. Their ability to deliver low cost air continuously throughout long operating periods is a big advantage for today—and for tomorrow.

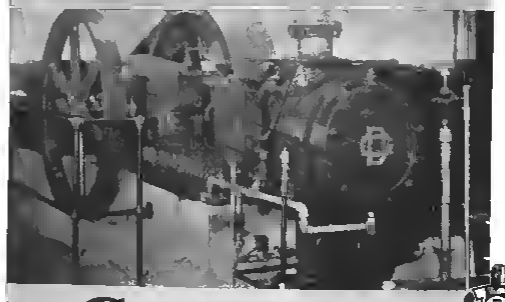
Here's how wise maintenance men have helped these compressors establish their performance records

- They have used a high grade engine oil to keep crankcase oil reservoir filled to proper level, and they have changed the oil every two to four months, depending on the service demanded of the compressor.
- They used only the best grade of air compressor oils for lubricating compressor cylinders—and they were careful not to use too much oil in the cylinders.
- They regularly cleaned the intake air filter at least once every week, when atmospheric conditions warranted.
- Every day, they tested all safety valves to prevent these important valves from sticking.
- They drained all air line water traps frequently.



GARDNER-DENVER "HA" TWO-STAGE HORIZONTAL AIR COMPRESSOR

1. Greater air capacity—under constant, fully automatic control—regulates air supply to fit your needs.
2. Large water jacket areas assure a cooler compressor for high efficiency and long life.
3. Unrestricted air passages and large valve areas assure high over-all efficiency. Timken main bearings provide smooth, economical operation.
4. Capacities from 468 to 2012 cubic feet displacement per minute.



GARDNER-DENVER "RX" SINGLE-STAGE HORIZONTAL AIR COMPRESSOR

1. Increased efficiency due to large and unrestricted valve and port areas and extra large water jackets.
2. Horsepower requirements are unusually low—and under constant, automatic control, to meet your air needs.
3. Low maintenance through extra years of service is assured by rugged, dirt-free "RX" construction.
4. Capacities from 89 to 1292 cubic feet displacement per minute.

GARDNER-DENVER

Address Gardner-Denver Company for further information on "HA" Two-Stage or "RX" Single-Stage Horizontal Air Compressors
Gardner-Denver Company, Quincy, Illinois

Since 1859

FULLY EQUIPPED AND MANNED·· for fast production of

AIRCRAFT PARTS



IN ALUMINUM AND STEEL··

● LYON'S modern, completely equipped Aircraft Division ... under the supervision of men specially trained in aircraft plants ... is constantly widening the scope of its production of aircraft parts and sub-assemblies. The facilities of this specialized division include:

1. Class "A" certified welders trained in our own school
2. Toolroom equipment and personnel for producing dies, fixtures and jigs to meet contract requirements
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6. War contract experience dating ing from July, 1940, and 43 years' experience in fabricating sheet metal

LYON METAL PRODUCTS, INCORPORATED
General Offices 1058 Madison Avenue Aurora Ill
Sales and District Offices Manned by Experienced Engineers in All Principal Cities

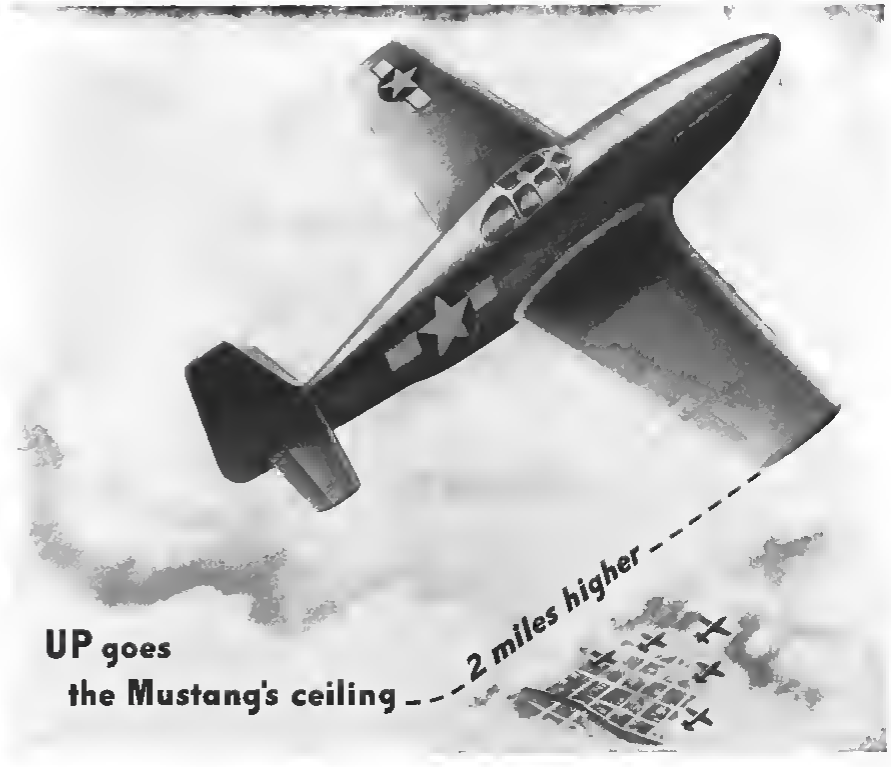
Lyon's Extensive Production Range Includes:

- Hydropress work
- Broke forming operations — aluminum and steel
- Hydrogen, acetylene and electric spot welding
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- Complete assembly work, including both welding and riveting

Write on your business letterhead for detailed information and book, 'Craftsmen in War Production'



LYON METAL PRODUCTS, INCORPORATED



UP goes the Mustang's ceiling ---2 miles higher

THE BOYS WHO'VE been flying the bullet-like North American Mustang say it's one of the Army's hottest fighters.

Time and again, though heavily outnumbered by the enemy, they've turned in spectacular box scores.

Imagine, then, what these hell-for-leather American fighter pilots are going to do when they get an even *hotter* Mustang—an even *swifter* Mustang—a Mustang they can push upstairs into the thin high air *farther* and *faster* than they ever could before.

And that's exactly what they're going to get!

For this superb plane is now being powered by the Packard-built Rolls-Royce engine, with a new supercharged surprise. *British and Packard engineers have found a way to skyrocket the Mustang 2 miles higher than its effective fighting ceiling used to be!*

Two more miles of blue sky for Mustang pilots to fight in!

To make this possible, Packard has added engines for the Mustang to its mass-production output—another contribution to the finest fighting Air Force flyers in the world!

PACKARD *Precision-Built Power*

ASK THE MAN WHO OWNS ONE





AIRCRAFT BEARINGS

Any Type..Any Size..Any Quantity

● Manufacturers of planes and aviation equipment have found Johnson Bronze to be an understanding and capable source of supply for their sleeve type bearings. Regardless of the kind required . . . cast bronze . . . powdered bronze . . . sheet bronze . . . bronze on steel . . . babbitt on steel, we can supply them to exact specifications.

For more than thirty-five years we have specialized in the complete manufacture of all types of sleeve bearings. This vast accumulation of experience enables us to assist manufacturers to select the correct bearings for each application . . . the proper method of installing each type . . . the measures to take in order to gain the greatest performance. Johnson Sales Engineers are available at all times to assist you. Why not call one in today?

***For the* ENGINEER:**

Complete, concise, authoritative data on all types of sleeve bearings in a handy loose leaf file is available FREE. Write for the complete set.

JOHNSON BRONZE

SLEEVE BEARING HEADQUARTERS

The MOST COMPLETE SLEEVE BEARING SERVICE in the WORLD

620 S. MILL STREET NEW CASTLE, PA.



..developed for space saving, weight saving, dependability *– in specialized aircraft uses...*

This Oster 1/100 H.P. motor is designed for continuous duty in high ambient temperatures; it operates satisfactorily in a 90° ambient — standing up under the most adverse conditions in blower applications... Behind it stands the 15-year performance record of Oster motors, used exclusively before the present war as original equipment on Oster motor-driven appliances. These Oster appliances, Oster-powered, have long been a recognized leader in their field, widely used by the armed services and other departments of U. S. and foreign governments...Type C-2B-1A is one of many Oster motors now being built to power vital instruments and mechanisms in airplanes and submarines. It is ball-bearing equipped, built in an aluminum die-cast housing. 6, 12, 24, or 115 volts DC; 115 volts AC . . . For satisfactory results that are a credit to your judgment, select Oster motors. Let us help you fit this or other Oster motors to your requirements.

M-12

John Oster Mfg. Co.

Department A-12 Racine, Wisconsin



The castering nose wheel on high speed fighters and heavy bombers alike can be a dangerous trouble-maker if uncontrolled.

Houdaille Hydraulic Shimmy Dampers provide ideal control of the shimmying forces which at times are of colossal magnitude—for they impose ever-increasing resistance as these forces mount yet offer little hindrance to slow wheel movements encountered in steering.

Behind these and other Houdaille aviation devices is more than a quarter-century of engineering experience.

THE HOUDAILLE-HERSHEY CORPORATION
Detroit, Michigan

BUFFALO ARMS CORPORATION
Buffalo, N. Y.

GENERAL SPRING BUMPER DIVISION
Detroit, Mich., and Chicago, Ill.

HOUDE ENGINEERING DIVISION
Buffalo, N. Y.

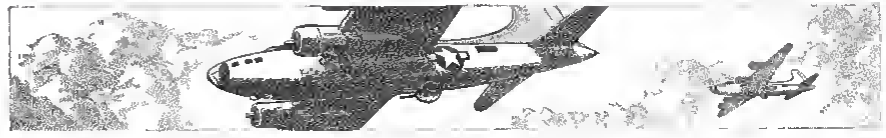
JACKSON BUMPER DIVISION
Jackson, Mich.

JACKSON CRANKSHAFT DIVISION
OF MUSKEGON MOTOR SPECIALTIES CO.
Jackson, Mich.

MUSKEGON MOTOR SPECIALTIES CO.
Muskegon, Mich.

OAKES PRODUCTS DIVISION
North Chicago, Ill., and Decatur, Ill.

SKINNER COMPANY, Ltd.
Oshawa, Ontario, Canada



W O R T H I N G T O N

AIRFIELD
"GRASS BLITZER"

The vital *"GROUND CREW"* for today's huge airports

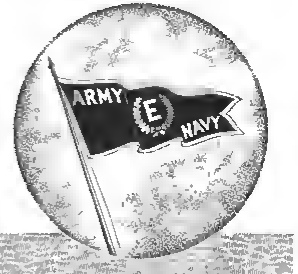
Just as bombers and fighters are kept in fighting trim by airforce mechanics, today's huge airports must also be carefully tended by their "ground crews"... to keep them fit..."to keep 'em flying." Turf cut regularly—experts advise 10 to 15 times a season depending upon the climate—assures the best take-off and landing conditions ... because dense, thick turf:

- **Keeps down dust which is a cause of the frequent motor tear-downs and plane parts replacement.**
- **Absorbs rainfall, preventing muddy areas and the danger of serious skids.**
- **Helps eliminate hazards of loose stone, gravel, etc., injuring propellers during motor runups, take-offs and landings.**
- **Assists in the control of soil erosion on these large treeless areas.**

WORTHINGTON, backed by 30 years' experience in turf mowing and maintenance, developed the "Grass Blitzer"—a revolutionary type of mower consisting of a high speed tractor pulling a 9-gang unit cutting a swath 21 2 feet wide—a mower that meets today's demand for speed and maximum acreage cut per day. These figures speak for themselves:

OLD TYPE LAWN OR GOLF COURSE GANG MOWER: maximum acreage cut per 8-hour day—approximately 88 acres.

NEW WORTHINGTON "GRASS BLITZER": average acreage cut per 8-hour day 280 acres—more than three times greater cutting capacity than any other combination tractor and gang mower now available.



Since July 26th the Army Navy "E" pennant has been flying over our plant—a tribute from the Armed Forces to our employees, to our suppliers and to our customers without whose wholehearted cooperation our full out wartime production would not be possible.



WORTHINGTON MOWER COMPANY
Home Office: Stroudsburg, Pa.

IRVIN Air Chute

SYMBOL OF SAFETY



The name "IRVIN" on the harness means the chute is produced in an Irvin Factory with over 20 years' experience and skill in chute-making.

Literature can be had by school or training executives for the asking. Address Main Office, Buffalo, N. Y.

IRVING AIR CHUTE CO., Inc. 1670 Jefferson Ave., Buffalo 8, N. Y.

Factories at other points in the United States, Canada and England



The CATERPILLAR CLUB

Founded in 1920. There is only one qualification for a life membership in an emergency use and women who have saved their lives with Irvin Air Chutes.

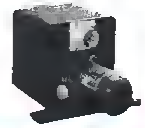
Many of the personnel of the flying services engaged in all phases of war have successfully used their Irvin Air Chutes in extreme emergency.

The word CATERPILLAR and the representation of a caterpillar are registered trade mark features of Irving Air Chute Co. Inc. We are anxious that the records of the Club be kept as complete as possible in the Club Register and members upon enrollment, will receive a caterpillar token with the name inscribed thereon. Communicate with Main office.

IRVIN Air Chutes

SERVING THE UNITED NATIONS' AIR FORCES





OUTWITTING THE WOLF PACK

Sworn foe of the wolf pack is the Vega Ventura bomber, known to the Navy as the PV-1. This new and deadly submarine weapon has only recently gone into active duty, but it has already proved itself outstanding as an effective convoy guardian.

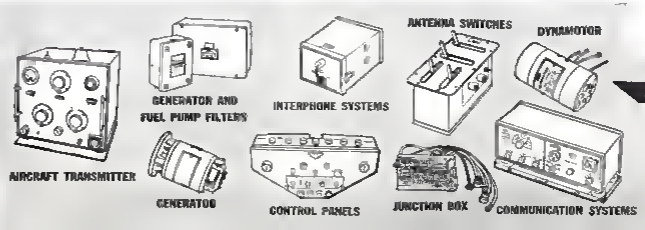
Helping to speed the deadly "ash cans" and torpedoes to enemy subs is Bendix Aviation, Ltd., Interphone Equipment which flies aboard the PV-1 as part of its Invisible Crew. With the life or death of Atlantic convoys in the balance, these radio controls must function with precision and reliability . . . always. *Bendix Aviation, Ltd., North Hollywood, California. Sales Engineering Offices in St. Louis, Dayton and New York City.*

Bendix Radio North Hollywood

BUILT BY THE BENDIX AVIATION CORPORATION

RADIO EQUIPMENT

In addition to its military radio and electrical developments, Bendix Aviation, Ltd., builds other equipment for commercial use, including this Position Light Flasher, approved by the C. A. A. and now in service. The unit has been specially designed for aircraft and weighs but 2 1 lbs. 12- or 24-volt operation is provided, and the unit has been tested for operation down to -55° C. Accuracy of the flashing mechanism is maintained by a constant speed, compound wound, ball bearing motor. Two-seat pilots conservatively rated to handle 6 amps assure long life. Should mechanical failure occur the white light automatically is turned on. Write for additional information.



THE INVISIBLE CREW

Precision Equipment by Bendix

AVIATION CORPORATION



TAIL LIGHT FLASHER

VACUUM RELAYS



More PRODUCTION AT Less EXPENSE FROM YOUR AIR TOOLS

● Carefully made of the best materials, from correct designs, CLECO pneumatic tools are built to stand the service on *any* job. However, increased production depends upon a few simple precautions, which often have no bearing directly on the tool itself. Here are a few:



Be sure to use the right grade of oil. In general, a light oil of high quality is what you need.



Avoid abusing the tool by rough handling, permitting parts to become loose; using unsuitable wrenches, or clamping the body of the tool in a vise. Leave repairing to the regular tool repair men.



Use adequate hose and pipe lines, with traps for water and trash.



Oil the tool about once an hour when the service is continuous.

Don't remove screens in connection bushings.



Use air of the correct pressure, generally 80 to 100 pounds at the tool.

50000 OF THESE FREE BOOKLETS ARE HELPING SPEED PRODUCTION

Have you sent for your copy?

The cartoons shown here are samples from our tremendously popular Cleco Cartoon Booklet, full of easy-to-remember operating instructions. Send now for your free copy.



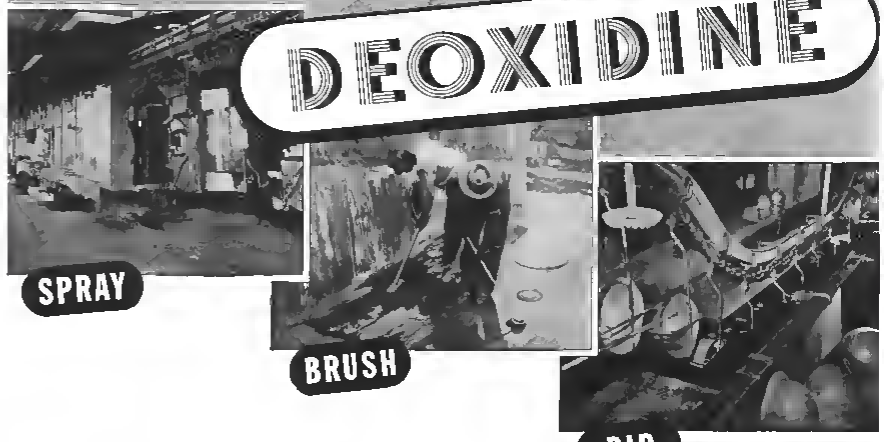
THE CLEVELAND PNEUMATIC TOOL CO.

Branch Offices in All Principal Cities — 3781 East 77th St., CLEVELAND 5, OHIO

RUST ?

No Problem if you use...

DEOXIDINE



DEOXIDINE is a time tested phosphoric acid metal cleaner that removes rust chemically from pits as well as from the surface and at the same time destroys or neutralizes rust producers. Deoxidine also removes oil, light oxides, annealing scale, etc., eliminating in many operations the necessity for a separate pickling.

Deoxidine may be applied by dipping, spraying or brushing. There are various types of Deoxidine adapted to the several methods of application and to the cleaning of surfaces with varying amounts of rust and oil.

Deoxidine which introduced the new principle in metal cleaning as long ago as 1916, is a proved material and standard practice.

Write for Service Data Sheet.

Manufacturers of Inhibitors & Metal Working Chemicals

AMERICAN CHEMICAL PAINT CO.

AMBLER ACP PENNA.

Note West Coast Plants may address inquiries and orders for prompt delivery to, Leon Finch, Ltd., 728 East 59th St., Los Angeles, Calif.

American Chemical Paint Company, Ambler, Pa.

Please send me general Technical Service Data Sheets on

☐ Deoxidine

*Name*_____

*Title*_____

*Company*_____

*Address*_____

J 10



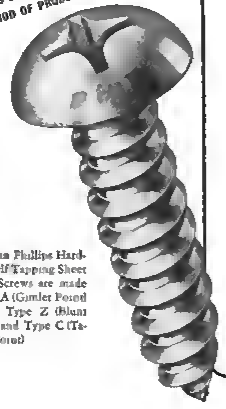
"The Boss is 20 Years Younger *since we cut our assembly time in half with* AMERICAN PHILLIPS SCREWS!"

Production comes out of the doldrums with a rush, when assemblies are changed over to American Phillips Screws. For then you're free of delays from slow, uncertain driving . . . crooked screws that have to be backed out and re-driven . . . spoiled work and broken screwheads . . . and lost-time accidents from slashed hands. The modern method of American Phillips Screw Driving enables new workers to do A-1 work right from the start . . . with the 4-winged driver and recessed screw head that align themselves to *drive automatically straight*, and set up flush-tight with the work surface . . . without physical strain or mental hazards. So production executives who change to American Phillips Screws not only pat themselves on the back . . . they get an *extra* pat on the back from all their assembly workers, too.

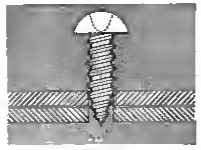
And what's more, they get 3 exclusive American advantages with every order. *American Value*, guaranteed by self-checking count, and individual inspection that makes sure every screw is A-1. *American Engineering*, that brings you all important improvements first, and helps with any special problems. *American Service*, that gives reasonably prompt delivery even in wartimes, because the American line is complete. You, yourself, can get rid of a lot of headaches . . . and hike production as much as 50% . . . by changing *now* to double-quick American Phillips Screws.

AMERICAN SCREW COMPANY
PROVIDENCE RHODE ISLAND
Chicago, 589 E. Illinois Street *Detroit*, 5-267 General Motors Building

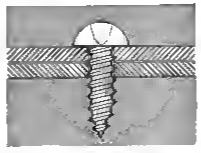
WORLD'S EASIEST, FASTEST, MOST ACCURATE METHOD OF PRODUCTION SCREW DRIVING



American Phillips Hardened Self-Tapping Sheet Metal Screws are made in Type A (Gimlet Point) shown, Type Z (Blunt Point) and Type C (Tapered Point)



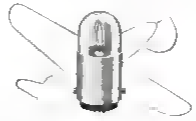
American Phillips Driver and Screw form a single, straight line driving unit . . . and stay that way until screw is completely driven in



American Phillips Hardened Self-Tapping Sheet Metal Screw sets up tight and straight in drilled or clean punched holes



Today you find TUNG-SOL Lamps serving throughout the world in planes, cars, trucks and tanks. TUNG-SOL has manufactured lamp bulbs since electricity replaced oil for automotive lighting. They are available for both initial equipment and replacement. You are assured of unsurpassed quality when you specify TUNG-SOL.



TUNG-SOL
AIRCRAFT LAMPS

TUNG-SOL LAMP WORKS INC. NEWARK N. J., Sales Offices: ATLANTA, CHICAGO, DALLAS, DENVER, DETROIT, LOS ANGELES, NEW YORK, PHILADELPHIA
ALSO MANUFACTURERS OF ELECTRONIC TUBES AND CURRENT INTERRUPTERS



GIVES INSTANT RESPONSE ON ANYTHING THAT ROLLS, FLOATS OR FLIES

Several years ago General Controls engineers set out to design a line of valves to function on aircraft, trucks, tractors or any type of moving equipment or machinery subject to severe vibration.

★When this line of valves was perfected it was given the name *hi-g* because of its ability to function in any position, regardless of vibration, change of motion or acceleration as indicated by increases in the "g" factor. Being light in weight, *hi-g* proved especially effective in airplane operations such as propeller feathering, wing flap and landing gear, anti-icing and temperature controls.

As America's war production swung into high, our plant facilities were turned over to the production of *hi-g* controls for use in aircraft manufacture. Today, *hi-g* plays a vital part in the construction of bomber and fighter planes. We are grateful for the confidence placed in our products by the aviation industry and proud of the opportunity to be of service during the present emergency.

GENERAL CONTROLS

Wartime Manufacturers of Electric Magnetic and Temperature Controls for Aircraft ● Peacetime Producers of Automatic Pressure, Temperature and Flow Controls

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BOSTON ● NEW YORK ● PHILADELPHIA ● DETROIT
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The WEEMS SYSTEM of Navigation Shows the Shortest Route to Tokio



DALTON DEAD RECKONING COMPUTER, TYPE E 6B Standard with Army and Navy Air Forces



AIRCRAFT PLOTTER MARK II, Standard for Army and Navy air navigators



OBSERVOSCOPE, a new device for quickly and easily learning or teaching star identification

THE Weems System of Navigation as taught at Annapolis and in flying schools at San Diego, Los Angeles, San Francisco, New Orleans, Miami and elsewhere was devised by Comdr. P. V. H. Weems, U.S.N., formerly a teacher of navigation at the Naval Academy and later a research officer for the Navy Department, and it is very highly accredited.

Star Altitude Curves, by Comdr. Weems, is believed to embody the quickest, easiest solution for position by stars. It is the basic principle of the astrograph, developed by the R.A.F. and adopted by the U. S. Air Corps and the U. S. Navy. The very first edition of his Air Navigation was awarded a Gold Medal by the French Aero Club.

DEMAND FOR NAVIGATORS EVEN IN THE GROUND FORCES

Even in the ground forces of every branch of the service there is a demand for trained navigators. The log of every plane on every flight has to be recorded and training in navigation is necessary. The job is tremendous and carries a Technician's or Warrant Officer's rating.

A diploma from the Weems School of Navigation will be invaluable to every air-minded recruit. The school offers a complete course by correspondence, so simplified that a knowledge of trigonometry or higher mathematics is not necessary. The cost is small. Write for information today.

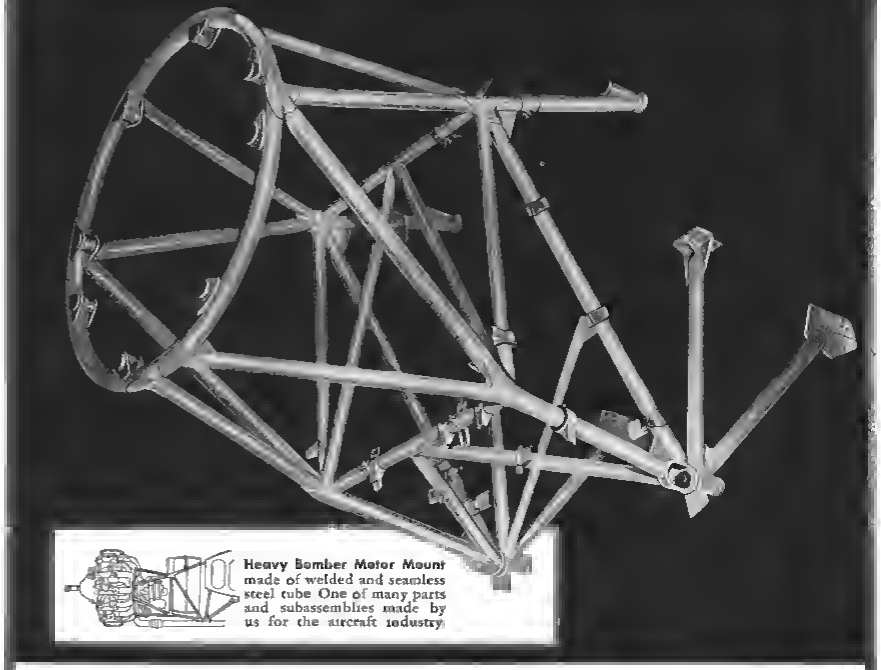
Be Prepared! **Know Your Navigation!** **Get a Head Start!**

WEEMS SYSTEM OF NAVIGATION

ANNAPOLIS, MARYLAND

AMERICAN METAL PRODUCTS COMPANY

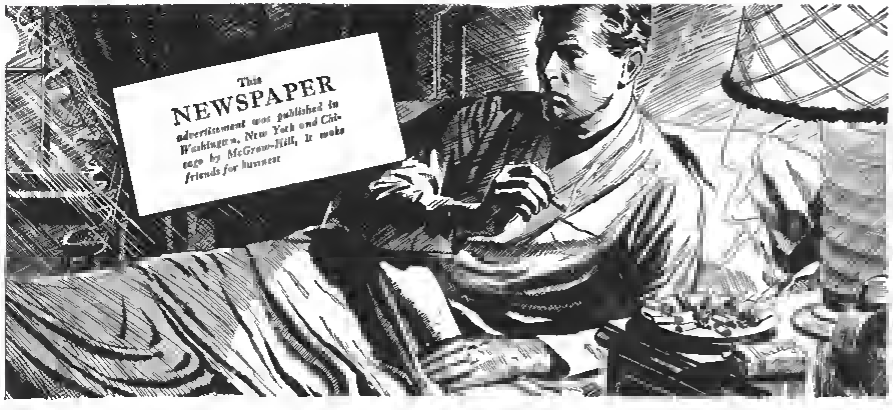
Manufacturers of Welded Steel Tube, Tubular Parts and Assemblies for the Aircraft Industry



Heavy Bomber Motor Mount made of welded and seamless steel tube One of many parts and subassemblies made by us for the aircraft industry

We are specialists in the quantity production of Chrome-Moly and carbon steel assemblies calling for upsetting, forming, swaging, forging, welding, heat treating and machining.

AMERICAN METAL PRODUCTS COMPANY, 3059 LINSDALE AVE., DETROIT, MICH.



Have you ever been out of a job?

What you can do

The best way to insure good jobs and better living is to create an environment favorable to continuous industrial progress.

The best way to insure healthy industrial progress is through a nation-wide understanding of the fact that we live better through doing more work in less time.

Nation-wide understanding of that fact will result in laws that encourage industrial progress.

Nation-wide understanding always will be a will-o-the-wisp, unless each business man does his share of: (1) Understanding his own responsibilities in maintaining industrial progress; (2) Explaining the relation between *good* business and good living to his employees and neighbors.

The newspaper advertisement reprinted here is McGraw-Hill's share in the job of explaining the source of good living. It has appeared in Washington, New York and Chicago, as well as in all McGraw-Hill publications. It is available, for use over your own company signature, in your plant city. A mat, six-column size for newspaper reproduction, will be sent to you upon request. Booklet reprints are also supplied at cost ($10.00 per thousand).

James H. McGraw, Jr.
President
McGraw-Hill Publishing Company, Inc.

IF you have ever been out of a job, and if you had a wife, children and slender resources at the time, then the fattest paycheck will never quite obscure the memory of the days and nights you lived with fear.

Some of that fear lingers in every man's mind, for all have suffered in some degree.

► That's why you hear the words "postwar planning" so often. Americans are determined that, one way or another, they are going to keep our thousands of factories going after the war, so that there will never again be a vast army of unemployed.

As usual, in a democracy, there are two entirely different ideas as to how to make 56 million jobs grow after the war, where only 46 million existed before.

Both kinds of people, who hold these different ideas, sincerely want to make the postwar world a better place for you to live in. They have complicated arguments, backed by lots of figures.

But when you trim all the arguments and figures down, you find that one side believes in DIVIDING jobs to make them go round, and the other side believes in MULTIPLYING jobs so there will be greater opportunity for all.

We believe in the MULTIPLYING plan for making postwar jobs and ask you to believe in it too.

Look back over our history. What made us great? Was it rich soil? Africa's is as rich. Was it

FREE MATS If you would like to publish this message over your own company name or distribute it in handy booklet form, write or wire: Research Dept., McGraw-Hill Publishing Co., Inc., 330 West 42nd St., New York (18), N.Y.

Have you ever been out of a job? (cont'd)

natural resources? China has them in abundance.

NO, the greatness and the good living of America is the direct product of her genius for doing more work in less time.

Invention is the source of improvement, and *improvement* is the multiplier of jobs . . . when products are improved in service or style, or lowered in price, new customers are attracted and new jobs created.

That's why it is true that good living has its source in industrial progress.

When industrial progress is interrupted, we have a depression, and there is less good living.

When (through courageous investment in new and better products) industrial progress is resumed, we go on to even higher levels of good living.

► If every able-bodied person in America is to have a job, then we must all understand the things that make good living possible, and we must all help *improve* the methods that have given so much good living to so many people already.

For businessmen, that means a constant search for improved methods and machines, a regular year-after-year investment in industrial progress. This means avoidance of such things as speculation in inventories that tend to create booms and depressions rather than consistent progress.

For every citizen, it means a constant search for the best ways and means to prevent and cure depressions.

Businessmen, alone, cannot prevent bad times. It's a job for *every* citizen. Every American can help just by knowing that good living comes from doing more work in less time. If you, and all other Americans, swing on to that fact, the laws that control our rate of industrial progress will be better designed to keep the improvement engine running.

That's where government really can be helpful in postwar planning.

It can encourage the "take a chance" spirit that is the basis of all progress. And it can improve the measures which prevent and cure depression. At present, our laws are not framed to encourage investment in new and better methods.

Many local, state and national taxes work out in favor of keeping an old machine, instead of buying a new one.

► There are tens of thousands of machines in the country that are over 20 years old. Even our shiny new war equipment is living 3 years in one, and will be old when the war is over.

Every machine should be regarded as obsolete as soon as it is installed and work started on a better one. In the long run, that is the best way to multiply jobs and create better living. Our laws should *encourage* the process, not *discourage* it.

New machines can only be bought with the profits created by old machines. The money that is laid aside by industry to develop and buy new machines is called "Seed Money." If laws take away too much of the Seed Money of business, that will prove disastrous. High taxes must be paid, but they should not destroy Seed Money, which is the only source of improvement.

That's why it's so important for everyone, no matter what his walk in life, to know this fundamental fact:

"Industrial Progress
is the Source of all Good Living."

THE McGRAW-HILL NETWORK
OF INDUSTRIAL COMMUNICATION

24 publications, which gather "war-news" from the "war-production-front" through a staff of more than 153 editors and 725 engineer-correspondents . . . More than 1,500,000 executives, designers, production men and distributors use the editorial and advertising pages of these magazines to exchange ideas on war-production problems.

McGRAW-HILL BOOKS

Publishers of technical, engineering and business books for colleges, schools, and for business and industrial use.

This advertisement is available in handy booklet form. (Less than 100 copies free. Larger quantities, $1.00 per 100; $10.00 per 1000.)

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Business Publishers International Corporation, an affiliate, publishers of Business and Technical Magazines for Latin America, and Overseas Circulation

America's greatest natural reCourse...

ARC WELDING

FOR MORE SHIPS



Last war it was 300 days for a Liberty ship. Today, through recourse to Arc Welding, they're batting them out in 30 days. Some yards quicker.

FOR MORE TANKS



Ordnance engineers by recourse to Arc Welding found faster output, greater strength and safety for tanks; made possible the victorious "General Sherman" M-4.

FOR MORE PLANES



Recourse to Arc Welding put the wallop in slow spots in the production of bombers fighters, trainers . . improved their designs, too.

FOR MORE ARMAMENT



Output of guns, scout cars, trucks, "jeeps", bombs was stepped up by recourse to Arc Welding in their design and in tooling-up fixtures.

FOR MORE OIL



"Big Inch" pipe line was streamlined from lush Texas to oil-starved East in less than a year . . does the job of 150 tankers . . foxed the subs . . . thanks in oil men's recourse to Arc Welding

FOR MORE PEACE JOBS



Look out for 50-mile-to-the-gallon autos . . new machines at startling prices . . tradition-smashing efficiencies . . war-developed devices, now hushed . . an end of jobs in smart plants (where recourse to Arc Welding is the rule)

THE LINCOLN ELECTRIC COMPANY . CLEVELAND, OHIO

Recourse: According to Webster, "a going to for aid or protection"

AVIATION, October, 1943



IT'S MAN MADE from metal and no bigger than a thimble, but it's helping to make our fighter planes more deadly — our air transports safer.

On stratosphere flights this tiny mechanism is the vital part of the Airco regulator which automatically controls the flow of life-sustaining oxygen. As flight altitude increases, it instantly increases the oxygen ratio. Like the supercharger, it has helped to push up the effective ceiling at which our war planes may operate.

This high altitude oxygen regulator is just one of many Airco products which link Air Reduction with the aviation industry. For example, Airco regulators control air or gas pressures in landing gear and in hydraulic systems. Airco and Wilson electric welding equipment speed construction of sturdy jigs and fixtures in airplane plants. . . Airco gas welding and cutting torches play a leading role in the manufacture of numerous aircraft parts.

Through these products, and through its research and Field Engineering Service, Air Reduction is helping to facilitate aircraft operation, production, and maintenance. For detailed information or technical aid, write your nearest Air Reduction office.

★ BUY UNITED STATES WAR BONDS ★

AIRCO WILSON

AIR REDUCTION

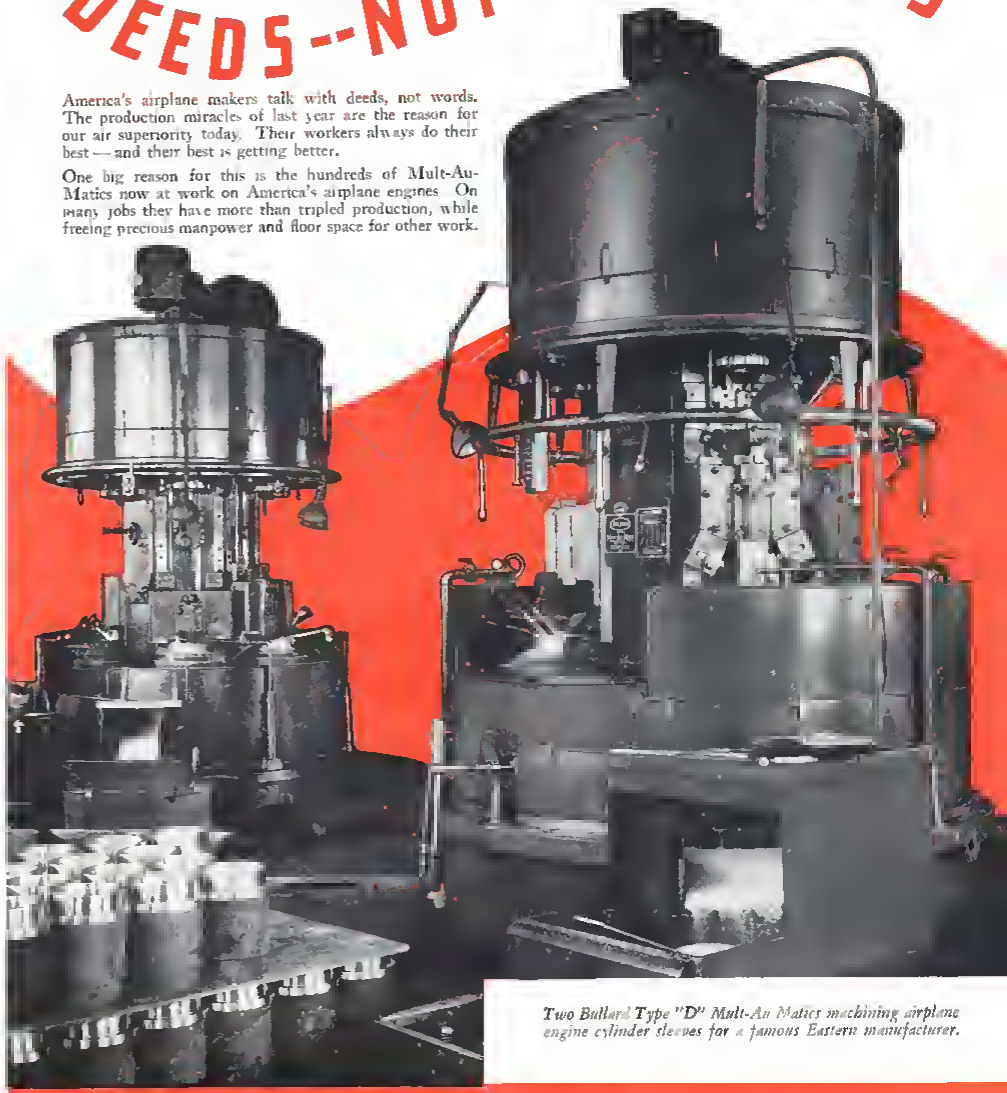
General Offices: 60 EAST 42nd STREET, NEW YORK 17, N. Y.

In Texas: MAGNOLIA AIRCO GAS PRODUCTS CO. • General Offices: HOUSTON, TEXAS

DEEDS--NOT JUST WORDS

America's airplane makers talk with deeds, not words. The production miracles of last year are the reason for our air superiority today. Their workers always do their best — and their best is getting better.

One big reason for this is the hundreds of Mult-Au-Matics now at work on America's airplane engines. On many jobs they have more than tripled production, while freeing precious manpower and floor space for other work.



Two Bullard Type "D" Mult-Au Matics machining airplane engine cylinder sleeves for a famous Eastern manufacturer.

THE BULLARD COMPANY

BRIDGEPORT 2, CONNECTICUT



For a View of Essential Applications of ACADIA SYNTHETIC PRODUCTS

● The unique Acadia combination—wide engineering experience and modern manufacturing facilities for the processing of synthetic rubber products—is playing a vital part in the mass output of modern fighting aircraft. The many applications to which standard and special types and shapes of Acadia Synthetic products may be put, suggest that you let Acadia engineers give you the whole story. Put their extensive background—and our facilities for production to closest specifications—to work for you. Write us today.

MOLDED PARTS
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PROCESSORS OF SYNTHETIC RUBBER AND PLASTICS
SHEETS • EXTRUSIONS • MOLDED PARTS

A PREDICTION ABOUT SPEEDI-DRI

OIL AND GREASE ABSORBENT

by

H. B. Barrett, President
BARRETT EQUIPMENT CO.
ST. LOUIS, MO.

We quote from a recent, unsolicited letter written by Mr. H. B. Barrett, President of Barrett Equipment Company:

"I thought I knew something about cleaning oily floors, but I'll admit that you showed me somethng that discredited my twenty-five years' experience with this problem.

"The remarkable action of SPEEDI-DRI is such that *I predict it will eliminate other types of floor cleaners for oily floors* as soon as it becomes sufficiently well-known.

"We shall be glad to have you use this letter to persuade those 'Doubting Thomases' who are always skeptical of a product that is new to them.

"I assure you that your success with this product should be remarkable."

Mr Barrett's prediction is rapidly coming true In thousands of war-busy plants and many safety-conscious industries SPEEDI DRI is doing better work more *economically* than any other product of its kind.

It is not only absorbing oil and grease, but is providing a non-skid surface, brightening up the plant; improving morale (especially among women workers) saving shoes from oil rot, protecting workmen's feet, saving manpower and scouring compounds.

Where else can you get so much for so little? Try SPEEDI DRI in your plant Prompt serv ce from warehouse stocks in leading cities. Unlimited, priority-free supply



Ask for demonstration or free sample If water or water-soluble oils are present, specify SOL-SPEEDI DRI

SPEEDI-DRI
OIL AND GREASE ABSORBENT

SUPPLIERS

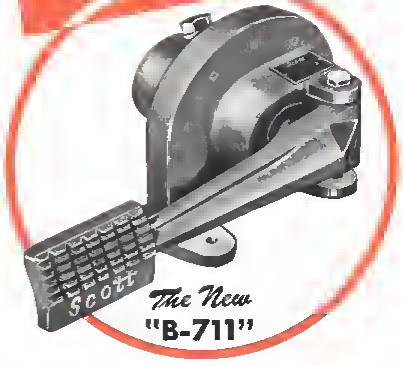
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West Coast
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Prompt Service from Warehouse Stocks in Leading Cities

BRAKES THAT SAY... "Whoa" and MEAN IT!



Developed by Scott engineers to surmount certain disadvantages of light aircraft hydraulic brake systems, the improved Scott "B-711" Brake Pressure Unit brings unusual efficiency and dependability to braking operations. Quick response and positive action is assured at all times due to their special pressure-tight construction. Scott Pressure cylinders are designed for expander and other types of hydraulic brakes. Readily installed, and located with pedals in conventional relationship to the rudder pedal. These units are simple in design, durably built, light in weight (only 21 ounces) Each unit is exactingly tested Economically priced. Write for illustrated folder.

A star has been added to this flag to indicate that all months of production under this ad

Scott
AVIATION CORPORATION
DESIGNERS AND MANUFACTURERS OF SPECIAL EQUIPMENT FOR THE AIRCRAFT INDUSTRY

BRAKE PRESSURE UNITS for Hydraulic Systems

How *TIGHT* Can A Man *TIE* A Rope?

Into the air on the decks of the first air freight carriers went machine tools, oil drums, sides of beef, lashed with ropes, trusting to the tightness of hand-tied sheep-shanks and square knots inherited from the centuries-old lore of the sea.

By journey's end, often as not the cargo was a peril to aircraft crews, had worked loose to damage itself and the plane.

Hand Methods Fail

The lesson, soon apparent to wary shippers and worried airline officials. A man just can't tie a rope tight enough to secure heavy cargoes against pressures developed in banking, climbing and sudden drops into air pockets.

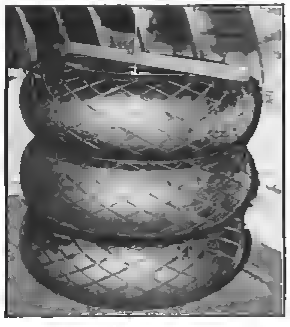
At Evans Products Company, a concern that has fathered other practical aids to shipping*, experienced, cargo-wise engineers worked out the answers. Among the facts they had to face.

The average man can exert only 60 pounds pressure in tying down cargo.

Of this pressure, 50% is lost by the time the packer knots the rope.

The upward strain exerted by air cargo against its lashings may be 2.4 times greater than its weight.

* Evans Auto Loader and Evans Utility Loader



Even to rope-wise loading crews no cargo poses a tougher tie-down problem than lives. One Evans Skyloader rod and locking beam cuts loading and off loading time to a matter of seconds, holds tight in flight.

Hand loading methods are costly. Rope, used haphazardly, loses 25% of its length in knotting, 30% in cutting and ravelling, adds useless cost to air cargo loading.

Skyloader—A Practical Answer

Result of this research and much field experiment was Evans Skyloader method, a simple system designed to tie down and hold down all types of air-borne freight. Skyloader equipment is of two types: Hooks and tighteners for use with rope lashing, hold-down rods and mechanically locked beams for heavier loads.

Simple to use, ingeniously designed for maximum leverage, Evans rope tighteners increase 10 times a man's effective strength in making cargo secure, ease the job of on- and off-loading, cut cargo handling time up to 50%.

In use, the end-whipped rope is first fastened to Skyloader hooks which fit into rings in the plane's deck. The rope is then passed over the cargo, fastened to deck rings and all slack is removed by a few twists of the Skyloader tightener. The tightener becomes part of the lashing, may be made tighter in flight. A single twist releases the cargo for fast off-loading.

Rods and Beams

For heavier loads, from oil barrels to jeeps—loads that would test the toughest rope, Evans Skyloader method provides metal tie-down rods and hardwood beams.



No fist-size puzzle of knots—a simple application of Evans Skyloader rope hooks and tighteners makes cargo safer in a matter of minutes, simple twists of the tighteners free the ropes, allow for fast off-loading.

On each side of a piece of freight, an upright metal rod is hooked into a deck ring. Over the rods is slipped a slotted hardwood beam which is jacked downward, locked tight against the load, makes it part of the airplane.

A Simple Method

The Evans Skyloader method offers a simple, fool-proof loading system applied as easily to crates of eggs as to Howitzers.

Equipment sufficient to tie down 12,000 pounds of freight is packed in the Skyloader kit measuring 52" long, 10" wide and 12" high.

To commercial air shippers as well as Army and Navy transport commands, Evans Skyloader method brings new speed, new safety, new simplicity and lightness to the growing job of stowing air borne freight.

☆ ☆ ☆

Vision to Anticipate the Needs of Tomorrow Creates New Industries Today

C. Evans PRESIDENT

EVANS PRODUCTS COMPANY
DETROIT

Evans War Products: Machine Gun Mounts • Tank and Automotive Heating and Ventilating Equipment • Aircraft Engine Mounts • Airplane Landing Gear Beams • Battery Separators • Prefabricated Houses • Plywood • Evans Skyloader • Evans Utility Loader • Evans Auto Loader • Evans Auto-Ruler • Evans Auto-Stop



from Every Angle THEY CAN DEPEND ON *The Type 27* SUPER AIRCRAFT RELAY

G-M

Originally designed for combat acrobatics . . . where strain and stress impose conditions unknown to pre-war relays . . . the Type 27 Super Aircraft Relay offers numerous advantages for a wide range of other uses.

Double trussed box frame construction provides rugged strength and rigidity . . . Measurements are 1½" x 1⅝" x 1⅞" and weight but 5 ounces. The type 27 SPDT double make—double break in 2 pole construction can withstand in excess of 15g without a flicker . . . has a 60 gram contact pressure (double make—double break) and a 20 ampere contact capacity at 30 volts d.c. (100 ampere inrush). Nominal coil voltage is 12 volts d.c. with a pickup of 6.5 volts (.61 watt) at 20° C. Coil wattage at 12 volts d.c. is 2.1 watts at 20° C. Temperature range is from —40 to +90° C.

Free samples of this relay are available to manufacturers on request if accompanied by a priority of AA-4 or better. Write or wire today requesting relay.



VISITRON PHOTOTUBES

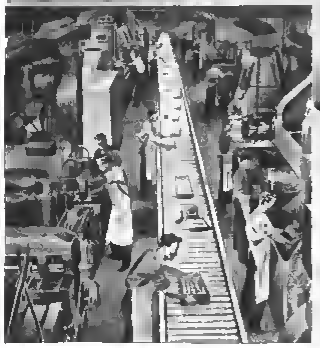
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Buy WAR BONDS & STAMPS









FLEETS OF AIRLINERS *Tomorrow!*

When Industry Reconverts to Peace, Standard Conveyors Will Be Increasingly Important Production Tools . . .

TODAY we outstrip the world in military aircraft manufacture. Tomorrow fleets of American-built passenger and freight air liners will be cruising the airways being explored and established now.

The American genius for mass production — with precision and speed — will carry on our war-won supremacy in all production.

Right now Standard Conveyors are helping industry to maintain peak production, conveying equipment will have an increasingly important place in mass production of tomorrow.

Plans for the future anticipate the needs of the aircraft and other progressive industries in the peacetime to come.

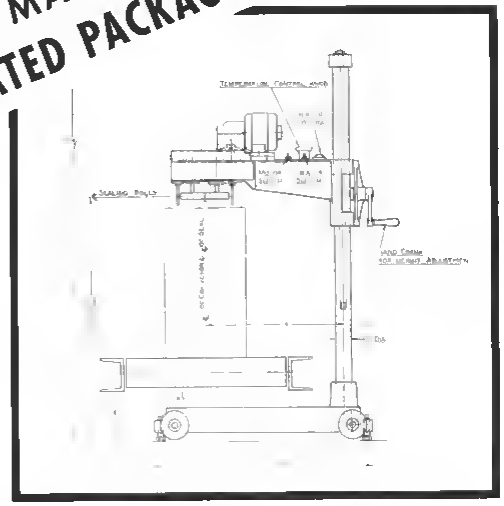
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STANDARD CONVEYOR COMPANY
General Offices: NORTH ST. PAUL, MINN.
Sales and Service in All Principal Cities



ENGINEERED FOR FASTER PRODUCTION

now! A POWER-DRIVEN, PORTABLE SEALING MACHINE for DEHYDRATED PACKAGING



Seals Pliofilm and other heat-sealing bags containing

- Cylinder assemblies
- Oil pumps
- Fuel pumps
- Carburetors
- Pistons
- Magnetos
- Superchargers
- Typewriters
- Spare parts

and other products that require protection against rust and corrosion

Here's the logical answer to the need for a faster and better method of sealing moisture-proof bags made of Pliofilm or other heat-sealing materials.

As the diagram shows, the machine is simply rolled under the standard gravity conveyor. Jacks lift it off the casters when in operating position. As the bags containing parts are moved along the conveyor, the top edge of each bag is fed through the sealing rollers.

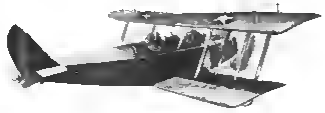
The head on which the sealing unit is mounted is quickly adjustable for various heights. Overhang of head allows sealing rollers to be centered over packages up to 30" maximum width. There is no limit to length of seal.

Perfect temperature control assures a strong seal without danger of overheating as in hand methods. Direction of rolls may be reversed by changing the motor leads.

Write for folder giving complete information

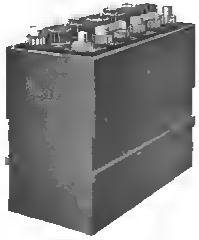
PACKAGE MACHINERY COMPANY
Springfield 7, Massachusetts
NEW YORK CHICAGO CLEVELAND LOS ANGELES TORONTO

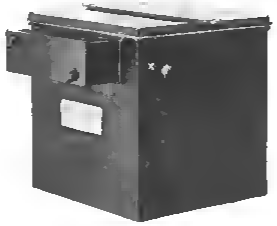
PACKAGE MACHINERY COMPANY
Over a Quarter Billion Packages per day are wrapped on our Machines





TEAMMATES IN 1917... ..AND *AGAIN* IN 1943





The average training plane could today outspeed and outfly the fastest fighters of World War I — but don't sell those early aircraft short. The equipment in them was the finest then available, including Exide Batteries developed for aviation needs with all the skill and precision of the time.

Today, Exide Batteries are again teamed up with the mighty bombers and fighters now flying in every theatre of war. Years of research, in the field and in the laboratory, plus the work of plane designers, manufacturers, and the Engineering Divisions of the Armed Forces, have resulted in these rugged new Exides. You'll find them in most of America's leading planes. Ask the boys in the ground crews. They *know*.

Exide
AIRCRAFT BATTERIES
IN THE AIR SINCE 1917

A letter we were proud to get

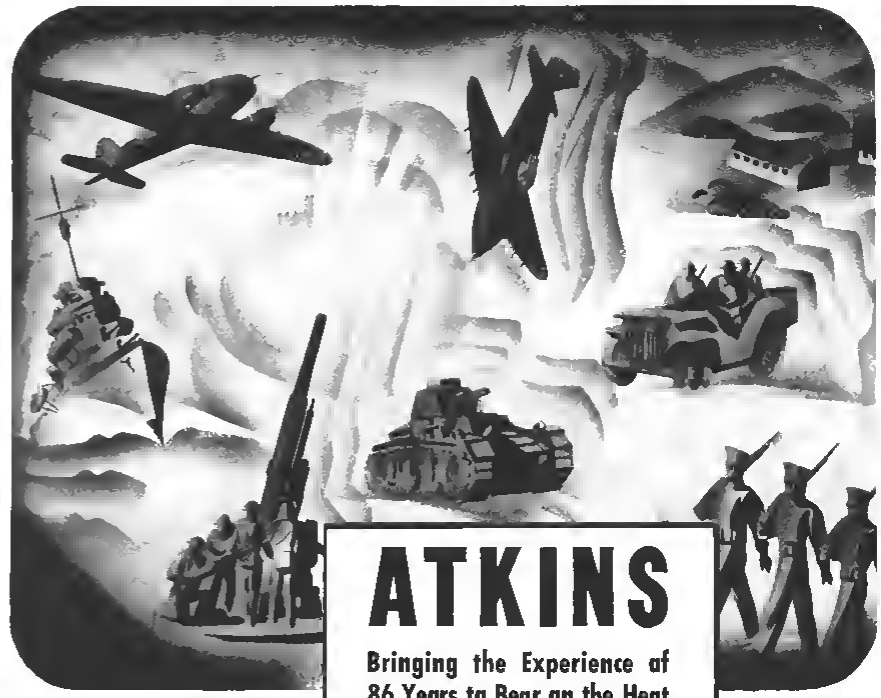


With 1075 former Exide workers now serving in the Armed Forces, it's only natural that we hear a lot about the things out batteries are doing. A recent letter from an old employee says this about Exide Batteries:

"I enjoy news from the plant very much as it feels good to know what is going on concerning the workers whom I enjoyed working with. I received my silver wings and got my Staff Sgt. rating last February. I'm assigned to a B-17 outfit. All the B-17's (pride of the air force) are equipped with Exide Batteries. My duty is radio operator and gunner on the plane, and will they get hell when I get over there! Congratulations to Exide on the progress shown in production of vitally needed batteries. Keep up the fine work. Keep 'em rolling! and we'll keep 'em flying!"

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia • Exide Batteries of Canada, Limited, Toronto

BACK THE ATTACK—WITH WAR BONDS



ATKINS

Bringing the Experience of 86 Years to Bear on the Heat Treating and Fabricating of.

ARMOR PLATE

ATKINS
Originators of the
Curled-Chip
System of Metal Cutting.
Metal Milling Saws
Segmental Cold Saws
Powersaw Blades

It is common knowledge now that when America's fighters go into action, they do so with superior protection from enemy shot and shell. Atkins takes understandable pride in the fact that its extensive background in the heat treatment and fabrication of metals was found valuable in the production of light armor plate for the Armed Services.

Atkins capacity to supply this vital armament material is available to manufacturers of war equipment.

Write us for further information.

E. C. ATKINS AND COMPANY • 444 So. Illinois Street • Indianapolis, Indiana

THE PRODUCTION LINE EXTENDS TO THE *Front Line*



Packing by Method II, in which Davison pioneered, makes scenes like the above possible. Complete engines arrive at the battle front free of rust and free of slushing compounds, ready for immediate use without the waste of time in deslushing oils and grease.

Davison Protek-Sorb Silica Gel insures against rust and corrosion because it removes the cause—moisture vapor. The engine or spare parts from the time they leave the factory until they reach their destination are sealed in an atmosphere where rust and corrosion are impossible . . . because Davison's Protek-Sorb has removed all the moisture vapor from the packages.

Davison science and research have seen the job through. The task is not finished when the engine or part leaves the factory; it must be preserved right up to the place where it is needed.

Davison Protek-Sorb Silica Gel is today successfully used to package

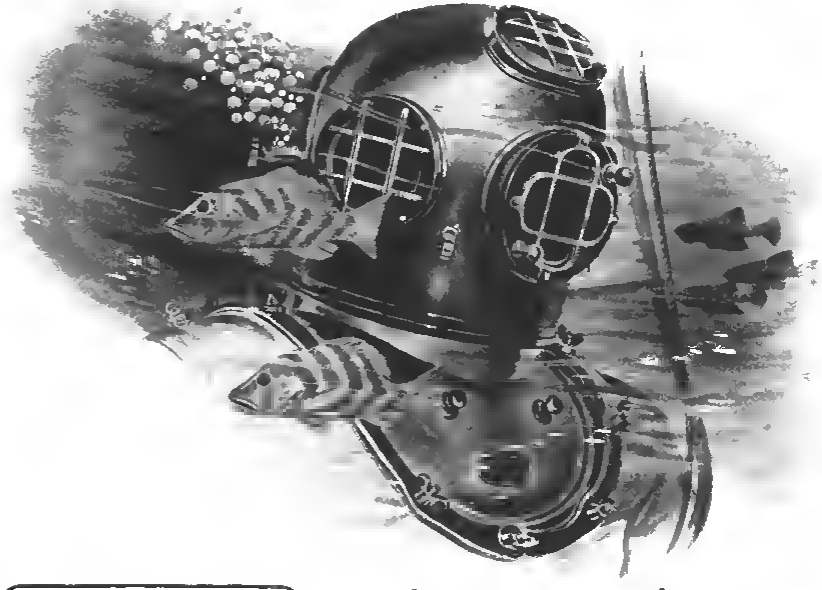
Complete Engines

Cylinders (run-in, with piston and ring)
Crank and propeller shafts
Carburetors, pumps, magnetos
Engine Superchargers
Propeller parts
Governors and Aircraft Instruments
Complete Airplanes
50 caliber machine guns
Bomb sights
Tanks
Directors
Fire Control Assemblies

THE DAVISON CHEMICAL CORPORATION

Progress through Chemistry

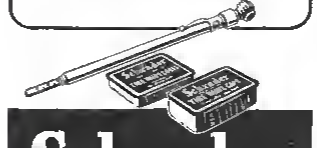
BALTIMORE 3, MARYLAND



INDISPENSABLE ALLIES IN TIRE CONSERVATION

Schrader Valves, Cores, Caps and Gauges save rubber!

Under-inflation is the greatest single saboteur of tires! You can control it. How? 1. Use a Schrader gauge to tell proper air pressure. 2. Maintain that proper pressure by using *Schrader cores* and by seeing that *Schrader caps* are on every valve. For, it's the *CAP* that guarantees an air-tight valve. 3. Check again with the air gauge from time to time to see that proper pressure is maintained. 4. Then if extra leakage occurs, look for a tube leak.



Schrader

CONTROLS THE AIR

ARMY E NAVY

A Hint From a Diver's Helmet to

THE AVIATION INDUSTRY

During the past 75 years Schrader has made thousands of Diver's Helmets—with safety valves, regulating and control valves. Accurate? Reliable? Where human life is at stake nothing must fail! Schrader devices control the air.

DEPENDABLE

No! Schrader products will not fail. In the aviation industry Schrader valves, cores, caps and gauges are playing a vital role in tires and shock struts. Other Schrader valves used in life rafts, life vests, barrage balloons, oxygen equipment and in other important products also play their part in helping win the war! You can rely on Schrader products. You can specify them with complete confidence.

IN MANUFACTURING PROCESSES

To speed production, to increase safety and to decrease costs—compressed air is being used more than ever before for machine control, safety control and ejection methods! Investigate the advantages of compressed air and the Schrader devices available to put it to its most efficient use.

SCHRADER PRODUCTS HELP SAVE RUBBER

Replaceable Tire Valves • Cores • Caps • Convertible Valves • Air Chucks • Repair Tools Pencil Type Gauges • Service Gauges • Blow Guns and Nozzles • Airline or Hose Couplers

A. SCHRADER'S SON, *Division of Scovill Manufacturing Company, Incorporated*, BROOKLYN, NEW YORK



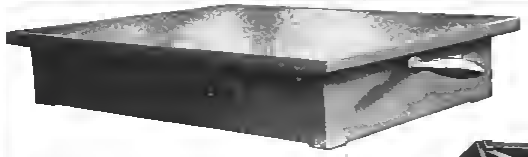
Peck Screw Machine Products are made in all metals and in sizes up to 1¼"—milled, drilled, slotted, tapped, threaded. Extreme precision measurements when required. High, uniform accuracy. Close attention is paid to every detail of the work as specified.

Although our Screw Machine Products Department is busy in the extreme with war work, jobs end from time to time and have to be renewed. We ask, therefore, that you send us your orders or requests for estimates now, so that we may schedule them for as early delivery as possible.

PECK SPRINGS and SCREW MACHINE PRODUCTS

The Peck Spring Company 30 Summitt St., Plainville, Conn., U.S.A.

Accurate SURFACE PLATES



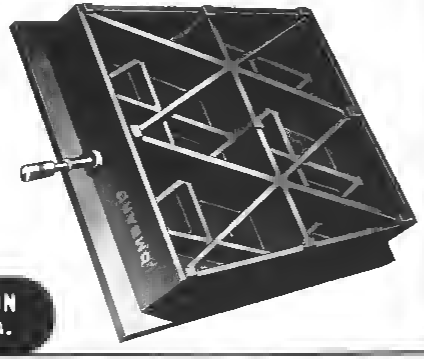
for Prompt Delivery!

For immediate delivery place your order now before stock items are exhausted. If possible give alternative size. Write Dept. 29 for latest Precision Equipment Catalogue

Representing the acme of what precision inspection equipment, Lombard Master Style Surface Plates are now available from stock. With their scientifically designed ribbing, three point suspension and extremely rugged construction these master accurate surface plates are carefully heat treated and hand scraped to extremely close tolerance. Commercial style surface plates are also available. These plates although of a different basic design are now being universally used for general inspection and shop use.

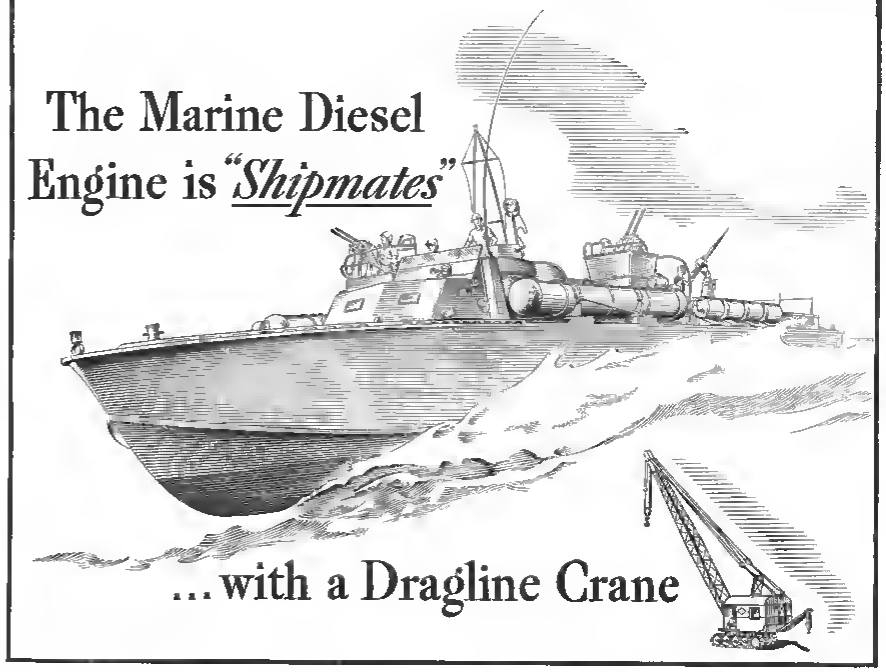
	Sizes	Types A	B	C
The Master Style	14"x18" to 48"x96"	.0001	.0003-4	.0005-001
The Commercial Style	8'x12' to 48"x96'	.0002-3	.0005-001	

Planer finish also available in both styles. All plates are furnished with lifting handles and finished wooden covers.



LOMBARD GOVERNOR CORPORATION
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The Marine Diesel Engine is "*Shipmates*" ...with a Dragline Crane



YOU MIGHT WONDER at the connection between a Marine Diesel engine and a dragline crane. The crane's is a back-breaking job in all kinds of weather, and maintenance must be taken with a grain of salt. Knowing this, crane companies wisely choose the Torrington Needle Bearing, famed for high load capacity, efficient lubrication and minimum service attention required.

Now the Marine Diesel engine is something else again—a miracle of compact engineering design that's got to be so thoroughly dependable it's all-fired ready at the bark of a command that selection of even small parts becomes a major consideration. So the Marine Diesel designers, too, specified the Needle Bearing—for its small size and reliable performance. But they discovered some other features that were right "on target," although hardly expected in a bearing.

The low starting friction of this unique anti-friction bearing, for example, meant quicker engine response, and maybe sub and PT-boat crews don't appreciate that. High load capacity helped prevent overloading, keeping more ships in fighting trim more of the time. The Needle Bearing's light weight saved pounds on board for fuel and ammunition, while its ready availability for essential applications enabled engine builders to go ahead on the Marine Diesel production that helped turn the tide in the battle of the Atlantic.

HAS THIS GIVEN YOU AN IDEA for your post-war designs? You may find the answer to one of your problems in the Needle Bearing's unique combination of features. For these are what your customers have been educated by war's developments to want in the peacetime products they plan to buy. Light weight, compact design, ease of installation, infrequent maintenance, long life—here are Tomorrow's sales points, and they add up to the Needle Bearing. Let a Torrington engineer show you how you can adapt the Needle Bearing's advantages to your product's design. For preliminary information, send for Catalog No. 114 which lists sizes, types and ratings, together with a list of typical applications.

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NEEDLE BEARINGS TYPE DC are complete self contained units consisting of a full complement of rollers and a drawn hardened outer race. They offer the advantages of small size, low cost, high capacity—and easy installation.





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THE TORRINGTON COMPANY

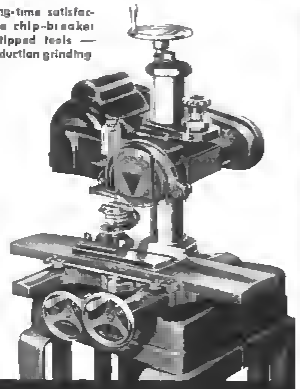
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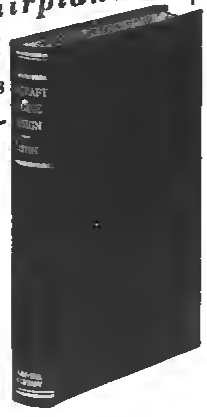
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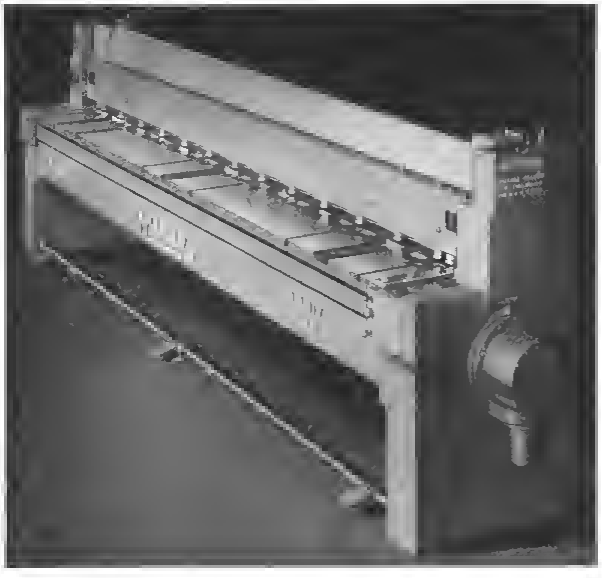
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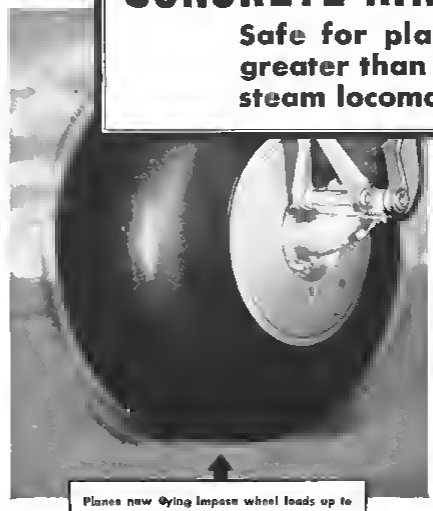
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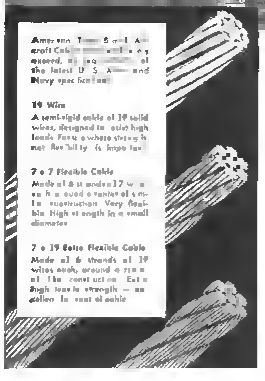
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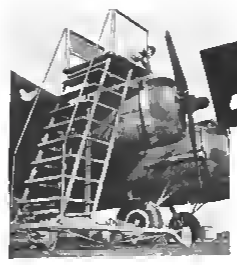
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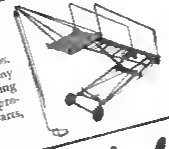
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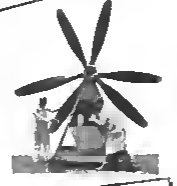


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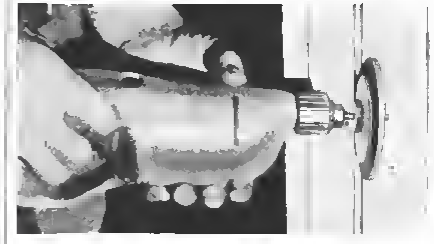


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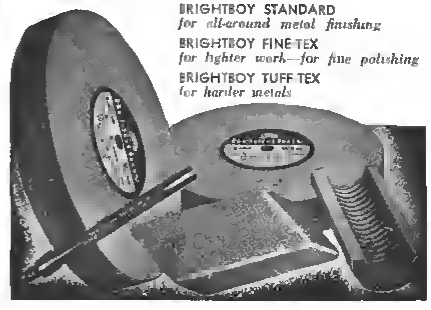
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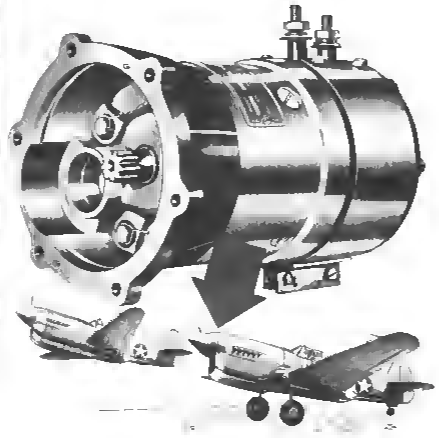
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*Designed by Eclipse Aviation Division Bendix Aviation Corporation and built by Eureka Vacuum Cleaner Company, Detroit.



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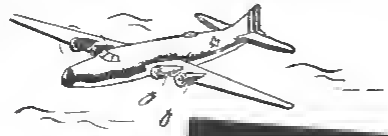
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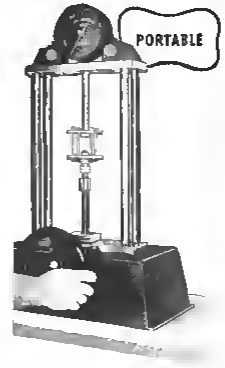
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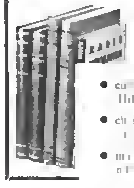
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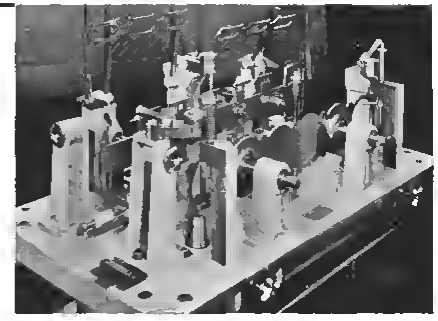
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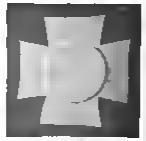


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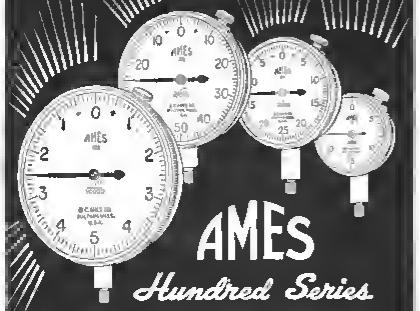
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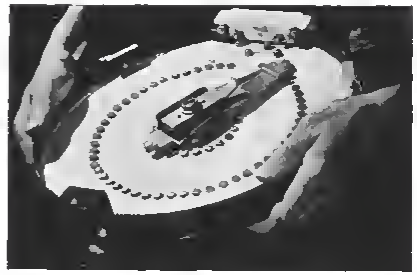
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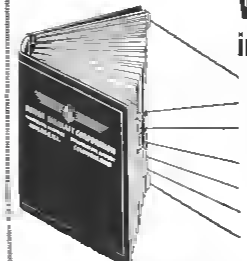
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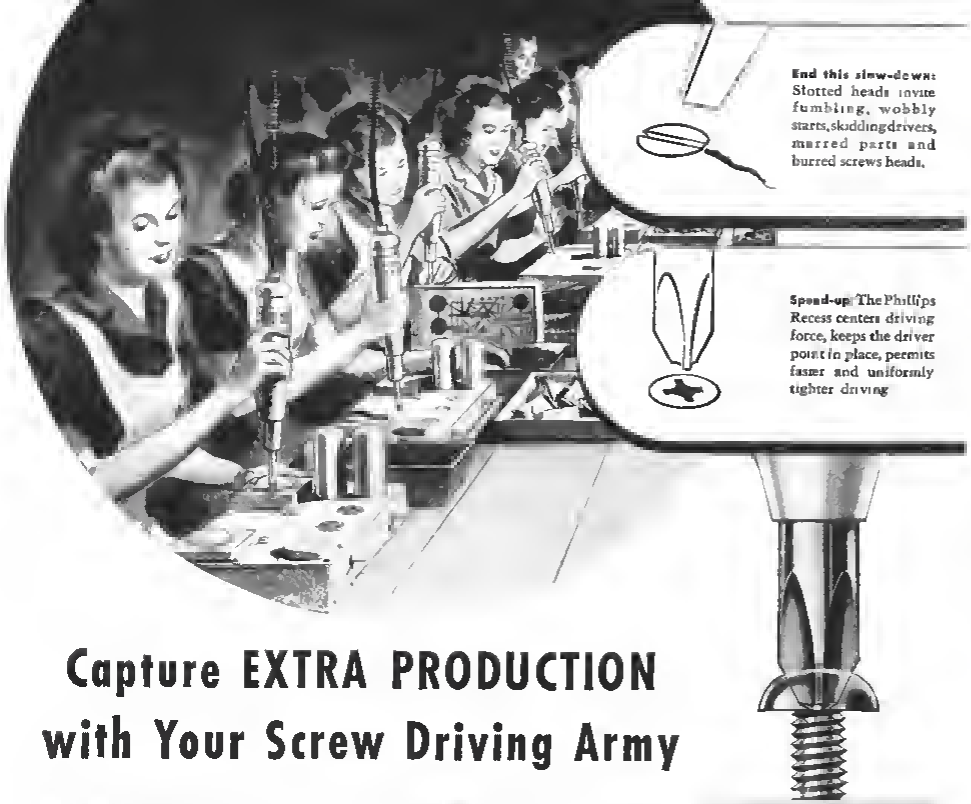
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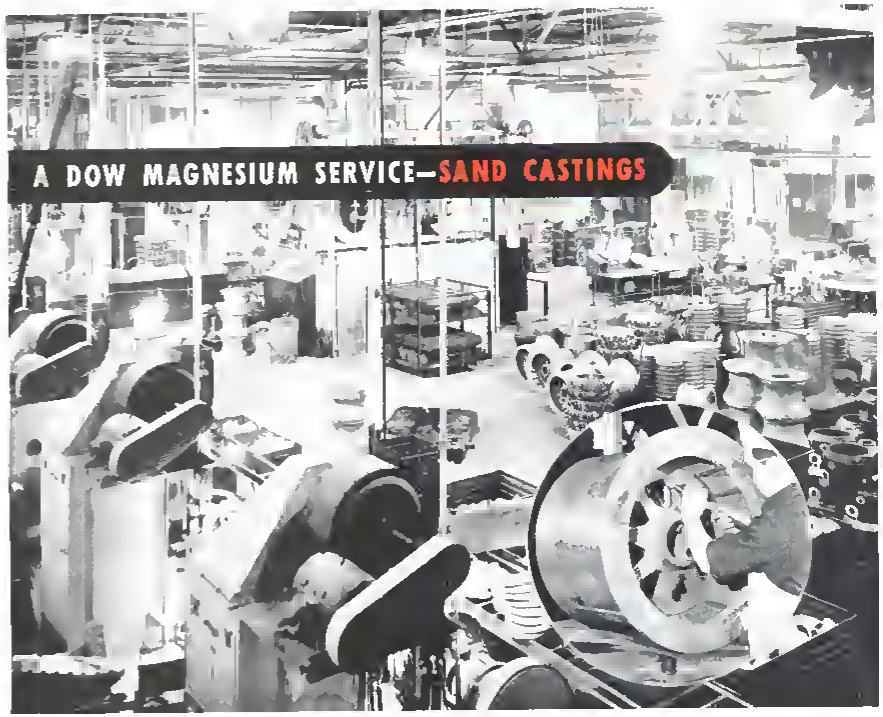


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